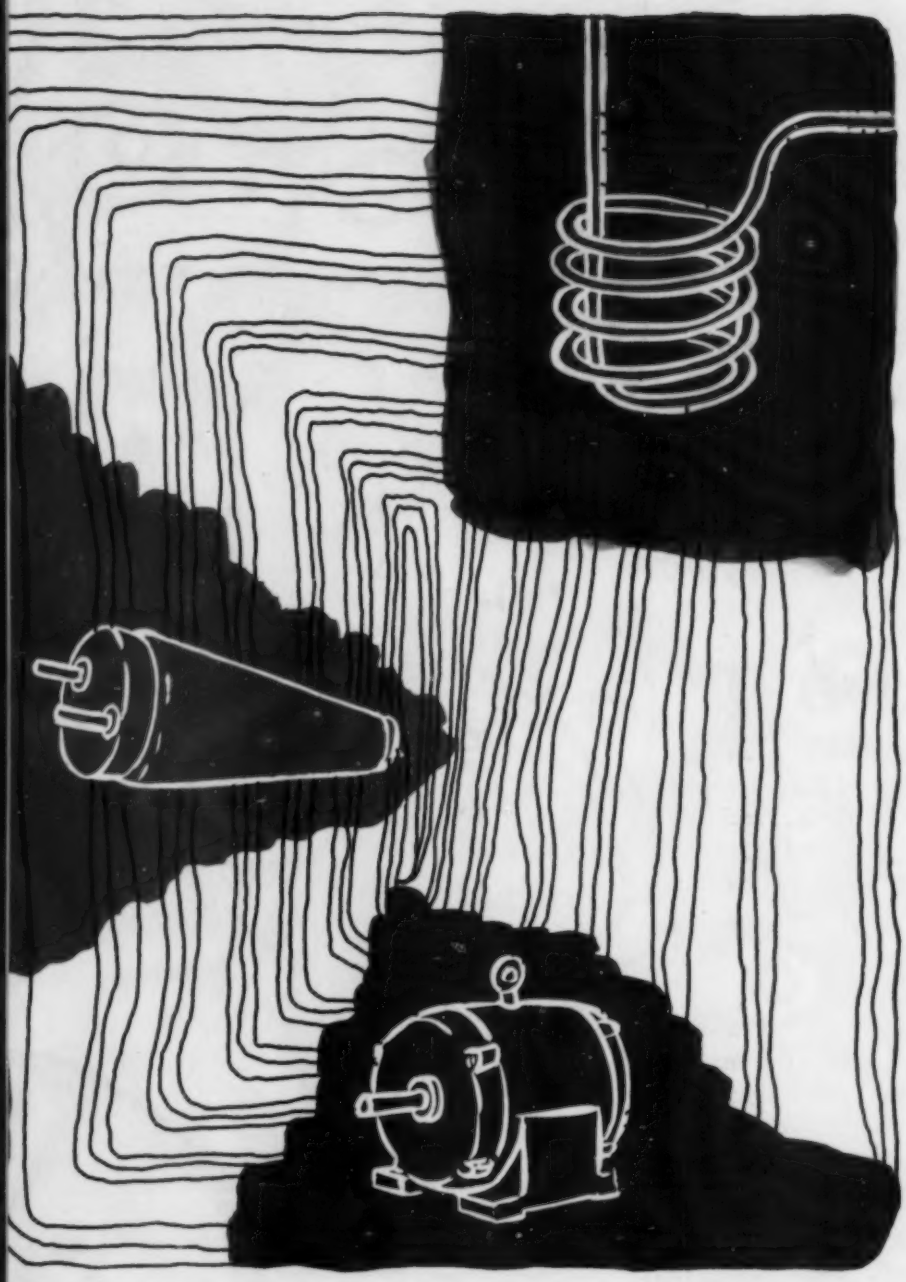
Industry and Power



August 1954

In-Plant Electrical Distribution
A staff prepared report dealing with trends in industrial electrical distribution systems. It covers significant factors from the selection of an energy source to final delivery of power to utilization devices. Starts on page 51

High Temperature Water
If it is temperature you need why not use high temperature water instead of steam? 47

Air Compressors
Tips on installation and maintenance of air compressors for longer life and increased output 75

Water Tank Maintenance
Water tanks can last longer than you think if they are given regular maintenance 78

Better Water
Smart treatment provides a good industrial water for a chemical plant 80

Longer Lumber Life
Treated lumber solves a maintenance problem in a Michigan paper mill 82

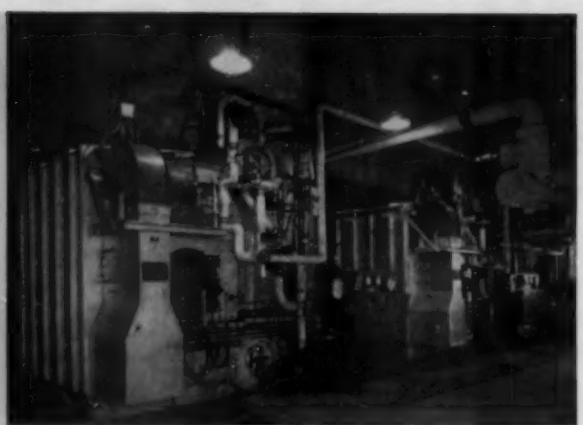
Cleaner Coolant
A new centralized system filters and pumps coolants for battery of machines 84

for engineers and executives responsible for

— engineered plant facilities

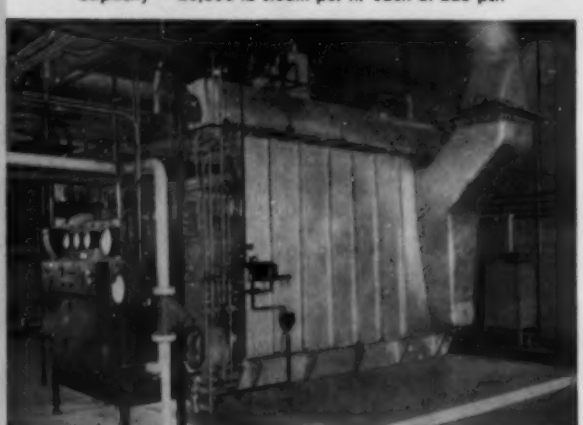
Why are they buying

VP BOILERS?



Industrial installation in the Midwest. Two VP Boilers. Capacity — 28,000 lb steam per hr each at 225 psi.

There's good reason for the fact that so many buyers of package boilers are finding that the VP offers them more for their money. For only in the VP will you find such significant *extra* features as —more water-cooling area per unit of furnace volume than any other boiler of its class . . . simple arrangement of baffles for maximum heat transfer . . . large lower drum for good accessibility and easy handling of load swings . . . quiet centrifugal fan, with less than half the noise level of typical high-speed blowers used on most other package boilers.

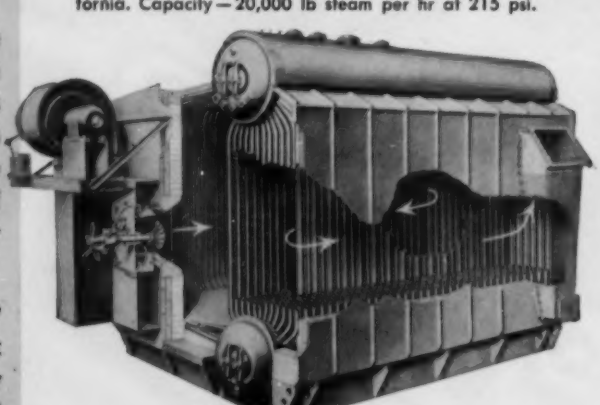


This VP Boiler serves a sewer pipe manufacturer in California. Capacity — 20,000 lb steam per hr at 215 psi.

Little wonder then that VP purchasers range from small companies to some of the largest in the country . . . industrials of all kinds . . . schools and institutions . . . various government agencies . . . even the Atomic Energy Commission. These users are employing VP Boilers for all types of applications — heating, process, and even power generation.

Make sure then that you have details of the VP at your fingertips when next you are in the market for a boiler of moderate capacity. Ask for the new Catalog VP-134, which contains specifications and general information on dimensions, space requirements, construction details and controls.

B-7484



Specifications — VP Boiler

Capacity — 4000 to 40,000 pounds of steam per hour
Pressures—Up to 500 pounds per square inch
Fuel—Oil or gas
Erection—Completely shop-assembled
Foundation—Simple concrete slab

C-E

COMBUSTION ENGINEERING

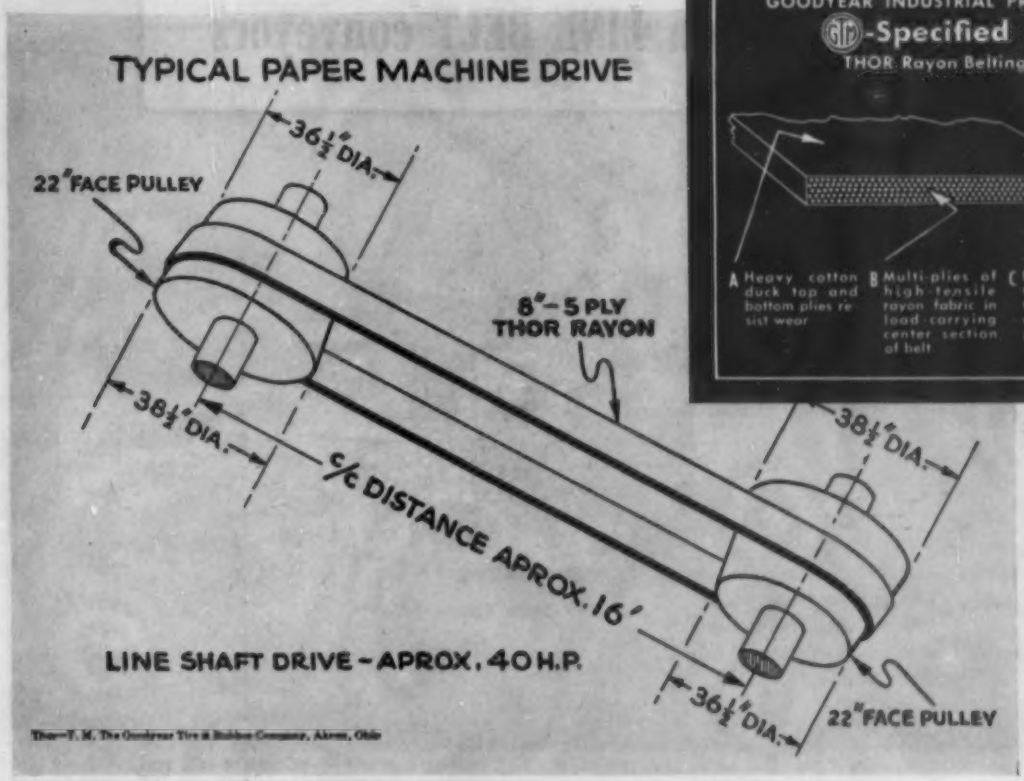
Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE

Circle 500 on Reply Card for more data

SERVICE MORE THAN TRIPLED

on cone pulley drives


TYPICAL PAPER MACHINE DRIVE
22" FACE PULLEY
36½" DIA.
8"–5 PLY THOR RAYON
38½" DIA.
c/c DISTANCE APROX. 16'
38½" DIA.
LINE SHAFT DRIVE – APROX. 40 H.P.
36½" DIA.
22" FACE PULLEY
GOODYEAR INDUSTRIAL PRODUCTS
GTM-Specified
THOR Rayon Belting
A Heavy cotton duck top and bottom plies resist wear
B Multi-plies of high-tensile rayon fabric in load-carrying center section of belt
C Belt cross-section is thinner to permit use over smaller pulleys

HEADACHES by the dozen were the cone pulley drives on paper-making machines of a large eastern mill. These drives regulate the speed of the paper over the drying rolls. Constant shifting of the belts from side to side stretched them, tore out the fasteners and generally reduced their service life to approximately three months. Since there is no allowable take-up on these drives, shutdowns were frequent and costly.

The G.T.M.—Goodyear Technical Man—recommended THOR Rayon Belting. At last report, these belts had delivered triple the service of their predecessors and were still going strong. Outstanding ability to hold fasteners and 30% less stretch than ordinary ply belts are the features of high quality THOR Rayon Belting that permitted this added service.

And this super belting has many other advantages: HP ratings 10% above standard silver duck plied belts—Thinner cross-section for use on smaller pulleys—Reduced bending stress—Mildew-inhibited throughout. Ask the G.T.M. for further details. You can contact him through your Goodyear Distributor, or write Goodyear, Industrial Products Division, Akron 16, Ohio.

YOUR GOODYEAR DISTRIBUTOR *can quickly supply you with Hose, Flat Belts, V-Belts, Packing or Rolls. Look for him in the yellow pages of your Telephone Directory under "Rubber Products" or "Rubber Goods."*

GOODYEAR

THE GREATEST NAME IN RUBBER

We think you'll like THE GOODYEAR TELEVISION PLAYHOUSE—every other Sunday—NBC TV Network

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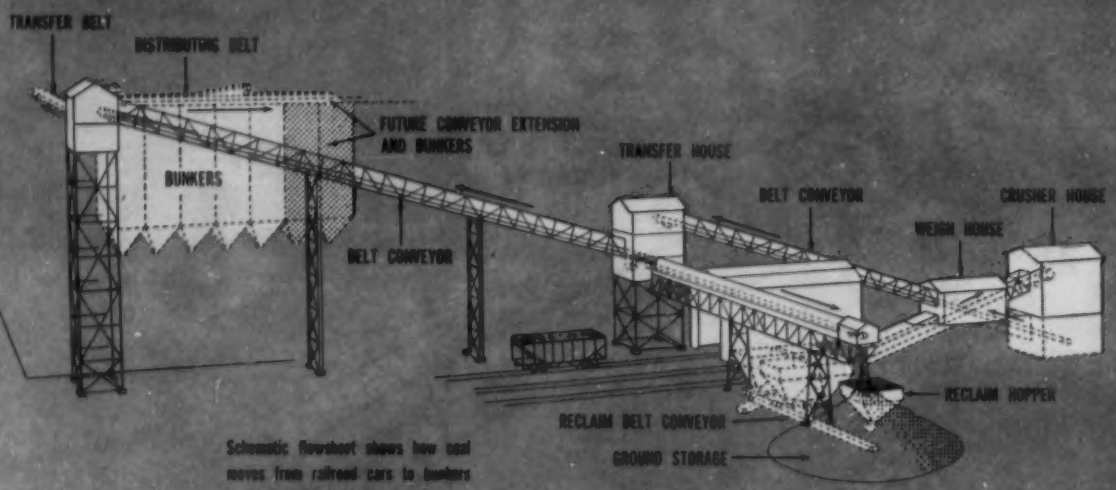
One of nation's most efficient stations moves coal on LINK-BELT conveyors



Schematic flowsheet shows how coal moves from railroad cars to bunkers at West Springfield Station of Western Massachusetts Electric Co.

Simple, flexible system designed for future expansion

THIS New England station's heat rate places it within the top group of the most economical in the U. S. Typical of this high efficiency is the Link-Belt coal handling system that is designed to carry twice the present 250 tph without a change in equipment. And, just as Link-Belt engineers worked hand-in-hand with Stone & Webster and the power company's staff, so they can help you get the finest in modern coal handling. Get in touch with your nearest Link-Belt office for a copy of Book 2410 that shows the latest layouts and equipment for power plants, large and small.

LINK-BELT

COAL HANDLING EQUIPMENT

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13.200

Belt conveyor in foreground feeds crushers. Crushed coal goes to bunkers or to reserve storage on conveyor in background.

Stocking-out conveyor is one of seven Link-Belt belt conveyors. Coal is weighed on its way to bunkers and in and out of storage.

Circle 502 on Reply Card for more data

Industry and Power

Published by Industry and Power Publications

Volume 67 — August 1954 — Number 2

FEATURE ARTICLES

Why High Temperature Water? 47
Owen S. Lieberg, Mechanical Engineer

In-Plant Electrical Distribution — Special Report ... 51
A staff-prepared 24-page report dealing with the principal trends affecting the character of industrial electrical distribution systems. This report is the culmination of extensive research covering the practices of the past few years and present-day plans — as these factors may be significant in the future. From the selection of an energy source down to the final delivery of power to utilization devices — this is a report on the trends now shaping up.
Additional copies of this report are available. Use coupon on page 117.

Air Compressors—Installation and Maintenance 75
H. W. Whiting, Worthington Corporation

Get Extra Life From Water Tanks 78

A Better Water at Lower Cost 80

Maintenance Headache Is Licked 82

New System Features Clean Coolant 84

Using Steel Strapping for Hanging Pipe 86

Cover Illustration — L. R. Sentowski, Art Editor

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COST CUTTING FEATURES

These important fuel-saving maintenance-reducing features are obtainable with Enco boiler baffles—*and only with Enco baffles.*

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- **Uniform gas flow**
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Each application is designed on the basis of more than a quarter century of experience in this specialized branch of power engineering. Installations are made by skilled mechanics.

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acorns

. . . recently announced . . . worth watching

Hot Bearings

• A major advance toward reliability of operation for propulsion steam turbines and reduction gears has been made by improving the method of measuring journal bearing performance. The conventional method—measuring the bearing lubrication oil discharge temperature at the combined sight flow and thermometer fitting—has given way to the more scientific method of measuring with thermocouples the oil temperature at the point of origin of the heat in the bearing.

Phenol-Waste Studies

• The industrial-waste pollution control plant, recently built by Koppers Co. tar products division at Follansbee, West Virginia, is the result of phenol-waste studies made by the Ohio River Commission during the last few years. These studies will prove helpful to plants with similar waste disposal problems.

Hush Hush!

• The nation's largest and quietest jet engine test cells have been designed by the Armour Research Foundation to test the Pratt and Whitney J-57, the most powerful jet engine in the free world. The test cells, located at Ford Motor Company's aircraft engine plant in Chicago, reduce the tremendous roar of the jets to a low murmur.

Hard Coatings

• A study of hard coatings for aluminum alloys outlines the findings of recent government research into the effect of hard oxide coatings on several aluminum alloys.

Industrial Audiometer

• A new audiometer that will enable industry to conduct more reliable and easier to operate hearing tests has been announced by the Beltone Hearing Aid Co. The audiometer will soon be in production after five years of research.

Plaster Casting

• A new plaster casting process will allow foundry production of parts formerly impossible to produce. The Aluminum Company of America expects the process to find important applications wherever engineered metal parts are presently used.

Fire Paint

• A fire retardant paint developed by the Glidden Co. is expected to isolate a fire to an immediate area until firemen have time to arrive. The paint is a resin-based interior finish that swells on contact with flame to provide a blanket of noncombustible ash over the wooden surface being protected

High-Speed Photography

• High-speed photography can be used to solve problems of improper dynamic reactions in the design of springs. This method has shown the way to simple corrections in such operations as engine valve lifters and electrical relays--where stroboscopic studies, in many instances, won't produce good results.

Atomic Competition

• Privately-financed atomic power plants will compete successfully with conventional power plants in five to ten years, according to Francis K. McCune, top atom official at G. E. The reactors best suited for most effective competition with conventional fuel plants are a light water-moderated and cooled boiling reactor, and a graphite-moderated, water-cooled reactor.

Better Bearings

• A new freight car journal bearing may eliminate the necessity of journal boxes. Advantages of the bearings are that they have a longer life and require less handling.

100 Degrees Below Zero

• Oil that lubricates even at 100 degrees below zero has been developed by the Elgin National Watch Co. Elgin scientists expect their oil to eliminate one of the greatest obstacles to successful Arctic military operations. Industrial uses will probably follow this development.

Pumping Varnish

• Pumping thick varnish at 500 F posed a six-year problem for the Sun Chemical Corp. Louis M. Barish, pump engineer, recently solved it with no squeezing or kneading of the varnish and a minimum of pulsation.

Special Qualities at Standard Prices

...in CHAPMAN Steel Valves

When you buy Chapman Steel Valves, you buy dependable operation and low maintenance cost — you can select steels to meet your specifications from over a dozen alloys made in Chapman's own steel foundry, under rigid scientific supervision.

When your valves are Chapman, you're sure they seat tightly and accurately, without jamming, chattering or wearing excessively. Close tolerances mean long service and little maintenance.

The Chapman Steel Valve line, — gates, globes, and checks, is complete for pressures of 150, 300, 400, 600, 900, 1500 and 2500 pounds and temperatures to 1000°F; all types of gates and globes excepting the 150 lb. class are available with 3 types of bonnet joints — welded, pressure seal, or bolted. Each has its own particular application depending on the medium to be handled.

Chapman's long experience and mass production mean economies. Quality is unsurpassed. So it pays to see Chapman first for every steel valve requirement . . . standard or special, gate, globe, angle or check. Chapman Steel Valves equal or exceed A.S.A. standards in every range. Write now for Catalog No. 20.

The CHAPMAN Valve Manufacturing Co.

INDIAN ORCHARD, MASSACHUSETTS

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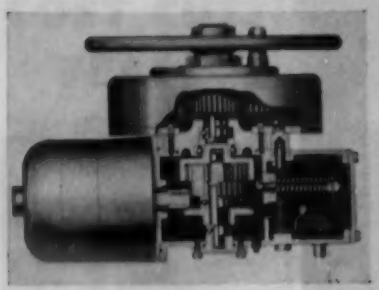
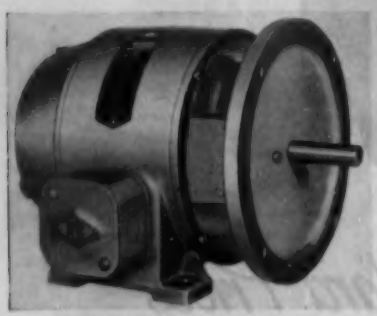
new equipment

. . . new developments



Valves are designed for stand-by control

H10 Torque-Master electric valve operators are designed for efficient and economical operation of all types of valves in sizes 2½ in. and larger. Basic design provides for a wide range of operating speeds, output torque, and length of travel to accommodate various valve designs and operating conditions. McBain Corp., subsidiary of Harvill Corp.

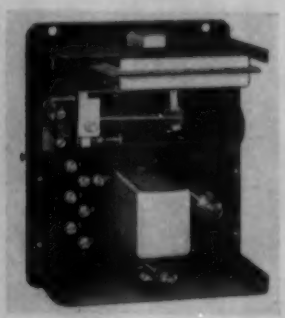


Unit automatically adjusts speed to load changes

H11 Reuland Electric Co. Torque Motors can be stalled or locked with current on without damage to the motor. The unit automatically adjusts its speed to intermittent load changes, at the same time maintaining a constant power. Ratings of standard units are from ⅛ through 10 ft lb, with across-the-line locked service duty of 5, 10, 25, 50, and 100 percent.

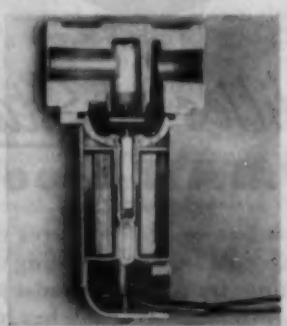
Cleaning unit simplifies tank maintenance

H12 Oakite Products, Inc. has developed the Model 531 interior tank cleaning unit especially for cleaning industrial tank interiors. Use of this unit makes it unnecessary for the operator to enter the tank. Nozzles rotate about two axes which are 90 deg apart and at such speeds that all surfaces receive the direct impact of the recommended detergent solution during each cycle.



Cut-off protects boilers, prevents shutdown

H13 To protect boilers in the event of mechanical or natural draft failure, and prevent nuisance shutdowns caused by momentary puffs, Cleveland Fuel Equipment Co. has designed the Lo-Draft Cut-off switch. It replaces conventional make-or-break switches and is suitable for all firing methods and boiler types.

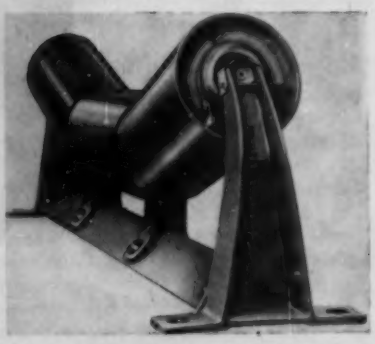


Unit provides wide range of operating speeds

H14 Diaphragm operated solenoid valves, designed for stand-by control of fluid flow and for automatic cycling operation on air compressors, are announced by Eclipse Fuel Engineering Co. Known as the DO line, the valves will operate on line pressures up to 150 psi and as low as ½ in. of water.

Unit heaters available in horizontal and vertical types

H15 For steam or hot water operation, the redesigned line of unit heaters offered by American Blower Corp. are built in both horizontal and vertical types in a wide range of sizes. Literature is available.



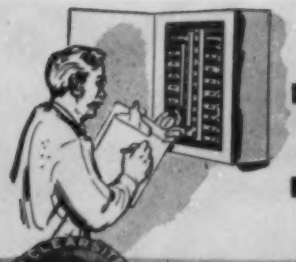
Idler is permanently lubricated

H16 The Jeffery Mfg. Co. announces MD and HD Series Belt Idlers with the new Duoflex Seal. The seal is said to keep out dirt and retain the grease for practically an endless period of time. The idler is factory packed, adjusted, and sealed. Design provides for easy roll removal without loosening or removing the stands.

Furnace meets wide range of space and size conditions

H17 Shipped as a packaged unit, the horizontal gas-fired furnace developed by Iron Fireman Mfg. Co. is delivered completely assembled with all controls except the thermostat mounted. Flue outlets on both sides of the cabinet make it possible to attach flue and draft diverter connections to either side. It comes in four sizes, ranging from 64,000 to 112,000 Btu at the

NOTE—Each new product item has a key number for your convenience in asking for additional, detailed information. Circle this number on Reply Card, pages 34/35—90/91.



PIONEERING

Since 1911

Means Time-Tested Fuses

Your best guarantee of Economy Fuse Leadership is Economy's record of nearly a half-century of pioneering.

Economy Renewable Fuses were the First to be approved by Underwriters' Laboratories, Inc. Economy introduced the first major improvement in the Clearsite* Plug Fuse that "shows when and why it blows". Economy pioneered, developed and continually improved such popular fuses as Arkless* Mechanical Indicating One-Time Cartridge, Eco* One-Time Cartridge and Renewable Plug.

"ECONOMY DELAY"* RENEWABLE FUSES ❶

Economy was the First to use inexpensive, bare, renewal links for restoration of blown fuses to their original efficiency, and to offer "Economy Delay" Renewable Fuses and Renewal Links, a favorite with industry since 1911.

ECON* DUAL-ELEMENT FUSES ❷

Recently Economy announced the new Econ Dual-Element Cartridge Fuses for controlled protection against unnecessary blowouts and against short circuits, thus rounding out a complete line of "fuses for every purpose".

***WRITE FOR BULLETINS** on the type fuses in which you are interested.*

*Trademark Reg.

Your Electrical Wholesaler has Economy Fuses in Stock

ECONOMY fuses for every purpose

See ECONOMY Advertisement in Special Electrical Distributor Supplement

ECONOMY FUSE & MANUFACTURING CO.

2717 GREENVIEW AVE. • CHICAGO 14, ILLINOIS

Circle 505 on Reply Card for more data

LOW INITIAL COST and widespread reputation for dependability were the big reasons why The American Agricultural Chemical Company selected a Worthington vertical turbine pump. They use it to maintain proper storage level of their water supply lake in dry seasons.

Worthington vertical turbine pump supplements lake water in dry season

PHOSPHATE ROCK IS WASHED DOWN on flat screens to underwater trommels at American Agricultural. The Worthington vertical turbine pump ensures an adequate supply of water during the dry periods when the impounded rain water level in their supply lake gets low.

In Pierce, Florida, The American Agricultural Chemical Company mines phosphate rock for processing into fertilizers and other chemicals.

In washer operations at their South Pierce Mine, American Agricultural uses over 2,500,000 gallons of recirculated water every working day. All the water for this vast operation comes from various mined-out cuts and lakes. During the rainy season, water is impounded in these areas for use in the dry season. In abnormally dry seasons, however, American Agricultural supplements its water storage by using a modern Worthington vertical turbine pump.

Like American Agricultural, more and more industrial plants are turning to Worthington vertical turbine pumps as the most economical means of supplying water. Users everywhere praise the low maintenance and power costs of these dependable pumps.

Write today for our Vertical Turbine Pump Bulletin W-450-B-39. Worthington Corporation, Vertical Turbine Pump Division, Harrison, New Jersey. 432

WORTHINGTON

THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB

CENTRIFUGAL • ROTARY • STEAM • POWER • VERTICAL TURBINE

CONSERVE GROUND WATER—IT IS A VALUABLE RESOURCE

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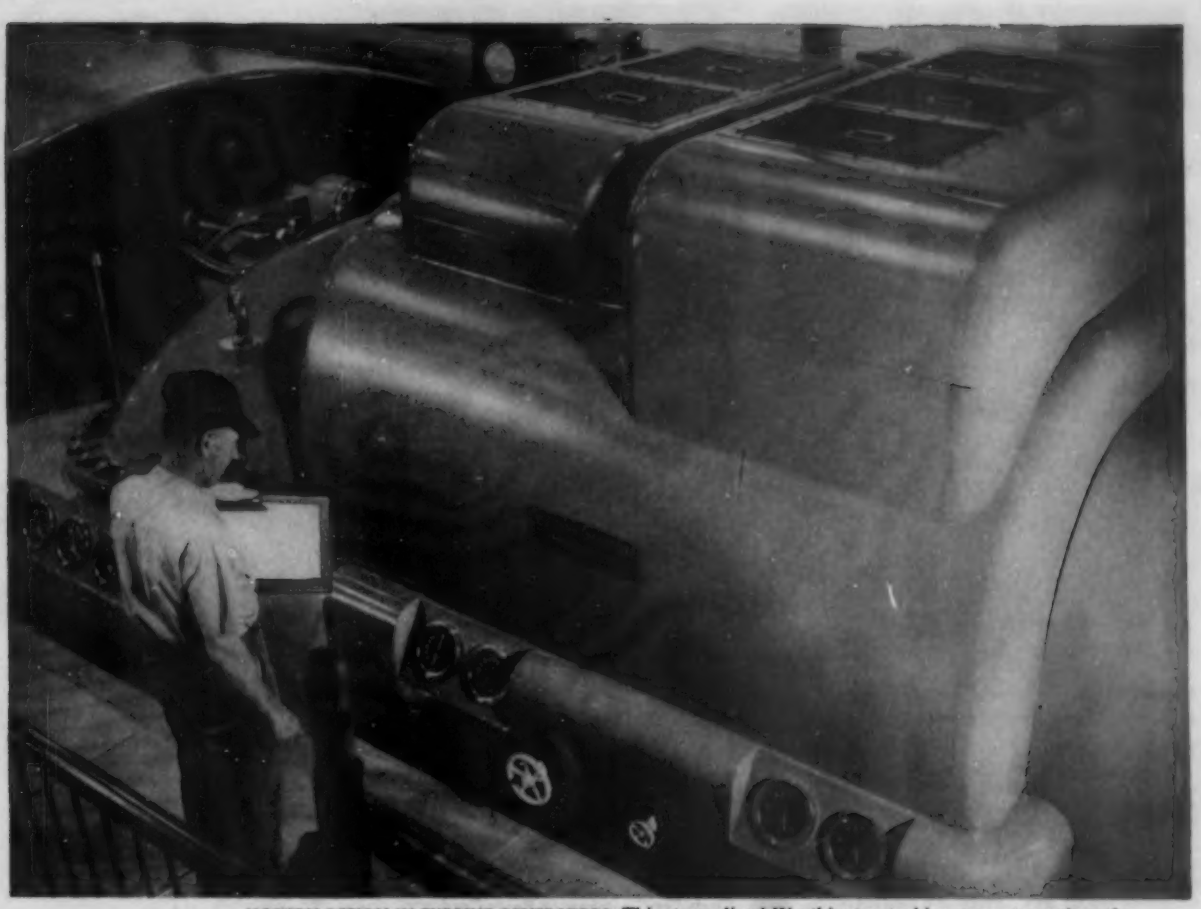


MODERN DESIGN IN TURBINE-GENERATORS. This streamlined Worthington turbine-generator unit at the University of North Carolina is capable of developing 2500 kw over and above the 10,000 kw normally produced. In addition, sufficient steam is automatically extracted to heat the University buildings.

Look how turbine-generators have changed!

Remember the bulky, complicated turbine-generators of only a few years ago?

Compare them with this sleek, powerful Worthington 10,000-kw unit installed at the University of North Carolina last year. Everything about this turbine-generator is modern and up-to-date.

Look at the streamlined heavy steel lagging which covers the turbine, generators and exciter. Note the recessed dials, set at a thirty degree angle so they may be read from standing height with ease. And the dials don't project into the room, where they might be damaged.

In addition to getting the most modern unit of its kind, the University of North Carolina benefitted by the undivided responsibility that goes with every Worthington turbine-generator. Each is designed, assembled, and tested as a complete unit *before* shipment.

Find out how Worthington turbine-generator sets pay off in longer, more economical power generation service. Sizes range up to 11,500 kw. Get in touch with your nearest Worthington district office for more information. Or write to Worthington Corporation, Steam Turbine Division, Section T.4.2, Wellsville, New York. T.4.2

WORTHINGTON

STEAM TURBINES

Single- and Multi-Stage Turbines • Turbine-Generators • Deaerators • Boiler Feed Pumps • Surface Condensers

A GREAT TEAM IN STEAM

Circle 507 on Reply Card for more data

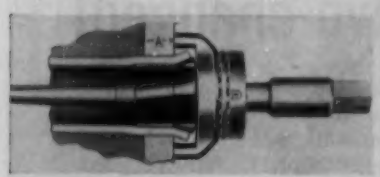
new equipment

—Starts on page 8

bonnet, and is specially designed to meet a wide range of application and space conditions.

Small steam generator designed for high-pressure duty

H18 To meet the need for a low cost steam generator for small commercial applications, York-Shipley, Inc. has developed the Steam-Pakette in sizes ranging from 15 to 30 hp for high pressure (125 lb) steam application. They can be used with light (No. 3) fuel oil, gas, or combination firing of either oil or gas. They are delivered fully wired to the control panel, requiring only minimum on-the-job wiring, and are built in accordance with ASME boiler code.

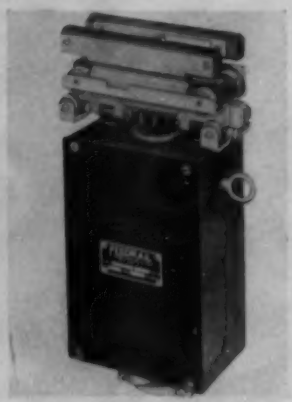


Tube expanders for packaged boilers

H19 Packaged boiler tube expanders, developed by The Gustav Wiedeke Co., are available in a complete range of sizes for every requirement. Parallel rolling and flaring type tube expander has a guard which holds the flare roll back while the tube is being rolled and flared into tube sheet.

Circuit breakers designed for industrial plants

H20 Type AB molded case circuit breakers introduced by Federal Electric Products Co., Hartford Div., are designed primarily for circuit protection in industrial plants and commercial buildings. Available in the Quicklag class and NE, NF, NK, and WL frames with ratings from 15 to 600 amp, 600 v maximum, they will pass temporary light overloads, but will trip instantly on heavy faults.



Trolleys feature full-rated take off

H21 Special Service Trolleys rated at 100 amp — equal to the full current carrying capacity of the Feedrail "100" track — are now available from Feedrail Corp. for equipment with motor loads up to 60 hp at 550 v ac. Both two and three pole trolleys are furnished completely assembled and internally wired. Literature is available.

TO REQUEST ADDITIONAL DATA

Circle "key" numbers on Reply Card between pages 34/35 & 90/91. Your requests will be handled promptly.

Thread compound eliminates seizing at high temperature

H22 High temperature anti-seize thread compound, known as Thred-Gard, is said to eliminate seizing and galling at operating temperatures up to 1200 F. It is non-hardening and acts as a lubricant to allow easy disassembly of threaded connections, even after lengthy service under severe conditions, according to Crane Packing Co., developer of the compound.

Air conditioning line includes horizontal and vertical models

H23 The new line of factory-built air conditioning units, known as Climate Changers, introduced by The Trane Co. includes both horizontal and vertical models, each in ten sizes. Capacity range is 600 to 29,000 cfm. The wide variety of coils available permits all practical combinations of heating, cooling, humidification, and de-humidification. Literature with roughing-in dimensions is available.

Coupling improves starting conditions

H24 Hilliard Corp. is now manufacturing the Twiflex Automatic Centrifugal Clutch Coupling under license from Compression Ignition Ltd. of England. The coupling is said to improve starting conditions and provide smooth acceleration on drives for high inertia equipment. It handles all types of misalignment and is made in a large number of sizes and several different types. Literature is available.

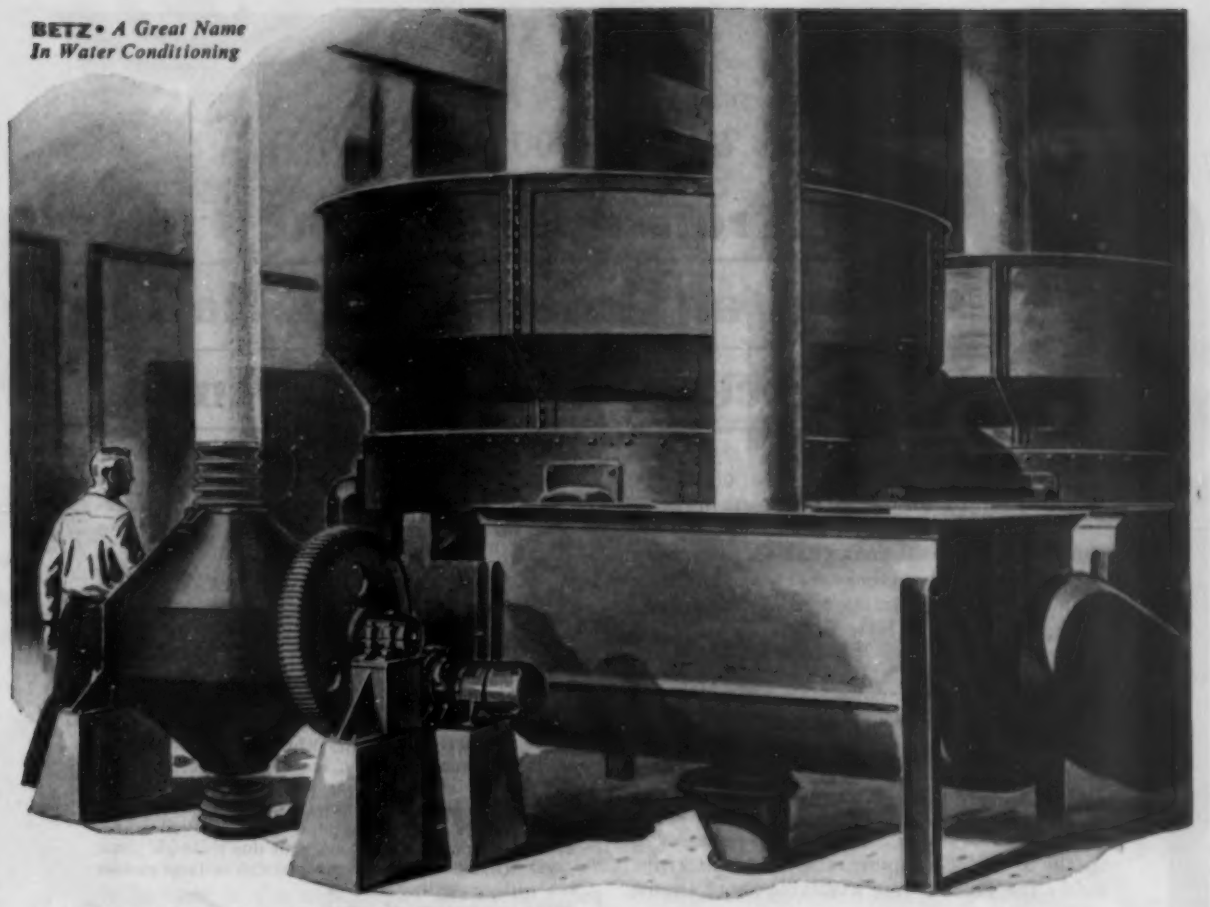
Units provide protection for wide variety of drives

H25 Adjustable Torque Limiter-coupling units that provide overload protection for a wide variety of machinery drives with direct-connected shaft are announced by Morse Chain Co. Maximum torque capacities are 130 ft-lb for the Model 555-1 and 260 ft-lb for the Model 555-2.

Transformers give lift to sagging voltages

H26 Compact, portable booster transformer designed by Marcus Transformer Co., Inc., to restore the proper voltage level on lines where inadequate voltage is encountered due to overloaded systems, is easily plugged into any line. It has a capacity of 3000

BETZ • *A Great Name In Water Conditioning*



If YOU could step into this picture...

. . . you would find yourself in Philadelphia . . . or Texas . . . or California . . . or Montreal . . . in one of the four Betz strategically-located mixing and formulating plants.

Here you would see a battery of giant mixers, whose fingers of steel effortlessly blend and stir thousands of "prescriptions", each formulated to solve some *individual* water conditioning problem for industry. Perhaps you'd notice a special packaging machine, the extremely accurate weighing apparatus . . . or maybe a ton or two of chemicals neatly stacked, ready for formulating.

A little further along, you'd see row upon row of barrels, drums, and boxes ready for shipment . . . each bearing a different contents label.

Perhaps then you'd feel, as many other visitors have, that this division of the Betz Organization *actually performs the function of a giant pharmacy*—the focal point of Betz engineering skill and experience.

And you would profit by your visit, too, since you'd obtain an idea or two on how your plant could operate more efficiently and economically through the use of Betz *completely-integrated* water conditioning service.

W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa.

In Canada: BETZ Laboratories Limited, Montreal 1.

BETZ

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

Circle 508 on Reply Card for more data

Proven On loads *UNDER* 600 Amps....

Fusetron dual-element Fuses Have an Interrupting Rating in Excess of 100,000 Amps.

An interrupting rating in excess of 100,000 amperes for FUSETRON dual-element fuses . . . this was shown by tests that were conducted under conditions that simulated the most severe field conditions. These tests were witnessed and verified by the Electrical Testing Laboratories of New York.

The test circuits were set to deliver far in excess of 100,000 amperes — yet the 250 and 600 volt FUSETRON fuses cleared the shorts without igniting readily flamable material placed around the fuses . . . and there was comparatively little noise.

These tests show that Fusetron fuses, even in the small 30 ampere range, can interrupt safely the most severe available short circuit current.

No interference with time-lag

Time-lag is of utmost importance to give proper motor and electrical protection and to eliminate needless blowing of fuses. Even though the interrupting capacity has been greatly increased, the time-current characteristic of Fusetron fuses has in no way been disturbed.

ALL THIS ADDED SAFETY

without changing a panelboard or switch . . . plus 10 point Protection of FUSETRON dual-element FUSES!

1. Protect against short-circuits. **2.** Protect against needless blows caused by harmless overloads. **3.** Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation. **4.** Provide thermal protection — for panels and switches against damage from heating due to poor contact. **5.** Protect motors against burnout from overloading. **6.** Protect motors against burnout due to single phasing. **7.** Give double burnout protection to large motors — without extra cost. **8.** Make protection of small motors simple and inexpensive. **9.** Protect against waste of space and money — permit use of proper size switches and panels. **10.** Protect coils, transformers and solenoids against burnout.

Fusetron Fuses Help eliminate needless Shutdowns for Production Engineers.

Work stoppages caused by needless blows are prevented. Even if all the motors on a circuit start at one time or other harmless overloads occur, the fuse link holds to prevent a shutdown.

Likewise, Fusetron fuses guard against needless blows caused by excessive-heating in panelboards and switches—lesser resistance results in cooler operation.

Fusetron Fuses Offer Maximum Safety for Electrical and Safety Engineers.

With an interrupting rating of 100,000 amperes, Fusetron fuses give the greatest possible protection against damage due to short-circuits. And just as important, they reduce the hazard of motor burnouts due to single phasing and overloading.

Fusetron Fuses Save Time and Work for Maintenance Engineers.

Once properly installed, Fusetron fuses require no costly inspection time or down-time for calibration and other maintenance necessary on mechanically operated devices.

Unnecessary repair work on motors is avoided because Fusetron fuses reduce to a minimum the danger of damage due to electrical faults. If trouble occurs, instead of rewinding or replacing burned out motors, simply replace Fusetron fuses.

Switches and panelboards are protected against damage from poor contact heating.

Fusetron fuses also protect against needless blows that cause irritating interruptions of regular maintenance.

Proven On loads *ABOVE* 600 and up to 5,000 Amps.

BUSS Hi-Cap Fuses Have an Interrupting Rating In Excess of 100,000 Amps. . . *and their blowing time can be coordinated with that of Fusetron fuses.*

An unlimited interrupting rating for BUSS Hi-Cap fuses on any voltage up to 600 . . . this was confirmed by tests reported by the Electrical Testing Laboratories of New York.

BUSS Hi-Cap fuses are designed to give protection against dangerous overloads as well as high fault currents — yet retain the speed of operation necessary to limit heavy short currents to safe values.

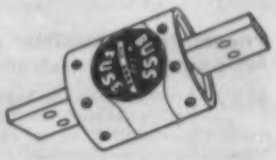
When coordinated properly with Fusetron dual-element fuses they will not open ahead of the fuse nearest to the fault — thus the trouble is isolated to the part of the circuit in which the fault occurs.

Added SAFETY on Old Installations

On installations where the increase in the capacity of the circuit has outgrown the interrupting rating of the circuit breakers, BUSS Hi-Cap fuses offer a safe and relatively inexpensive way to protect inadequate breakers against rupture in event of bad fault.

ACTION THAT SAVES YOU MONEY

Don't risk losses. Delay may cost you far more than replacing every fuse with a FUSETRON fuse. By passing the word along that all purchase and stock records should call for FUSETRON dual-element fuses on loads up to 600 amperes — and BUSS Hi-Cap fuses on loads above that, you get action that begets money saving.



On New Construction tell your architect to specify this Safer, Better Protection.

Fusetron Fuses Cuts Cost for Top Management.

Cuts maintenance cost — Fusetron fuses are maintenance free.

Cuts motor repair cost — Fusetron fuses guard the motor, against damage due to overloading, single phasing, short circuits and other electrical faults.

Cuts production costs — Shutdowns due to needless blows are eliminated.

Cuts new installation costs — Smaller sizes can be used, therefore big savings can be made on switches and panelboards.

Cuts present installation costs — Fusetron fuses hold and won't open on starting currents so the need for larger panelboards and switches is often eliminated — and in many cases new motors can be added to the circuit without installing larger panelboards or switches.

Play Safe—Install Fusetron Fuses and BUSS Hi-Cap Fuses now!

For blowing time charts or more information on FUSETRON fuses and BUSS Hi-Cap fuses use coupon or write for bulletin FIS and HCS.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

BUSSMANN Mfg. Co.
(Division of McGraw Electric Co.)
University at Jefferson, St. Louis 7, Mo.
Please send me complete facts about FUSETRON Dual-element Fuses and BUSS Hi-Cap Fuses.

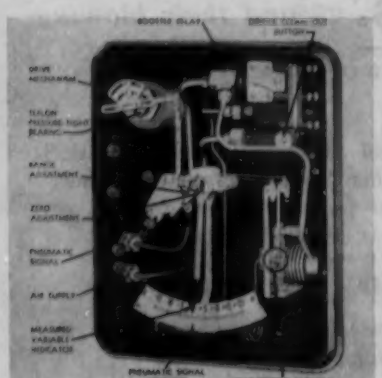
Name_____
Title_____
Company_____
Address_____
City & Zone_____ State_____ 954

Circle 509 on Reply Card for more data

new equipment

—Starts on page 8

w or 3 kva and is said to have an exceptionally high dielectric and thermal stability. It is equipped with plugs and outlets for 95, 105, 115, and 208 v to deliver 115 and/or 230 v in any combination.



Pneumatic transmitter designed for power plant instrumentation

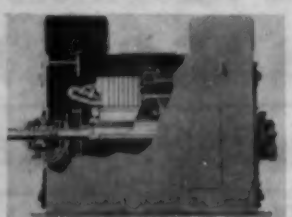
H27 According to the manufacturer, Bailey Meter Co., the Pneumatic Transmitter is available for transmitting measurements of flow, level, pressure, temperature, draft, differential, and vacuum. Transmitting distances can be 1000 ft to receivers, 400 ft to controllers. Accuracy is within ±½ percent of measured range span. Literature is available.

Roof valve releases heat and gas quickly

H28 The Swartwout Company's ventilator division has developed a roof unit known as the Fire Valve which opens quickly to relieve heat, gases, and smoke in the event of fire. Each unit provides 46 sq ft of free area opening when two large dampers drop, released by a fusible link device. A special bulletin describing this fire fighting aid is available.

Coating adheres to galvanized iron and zinc

H29 Metallic zinc dust, phenolic resin vehicle, and tung oil are combined by The Tropical Paint & Oil Co. to produce Zincoater, a coating that is said to adhere to any galvanized iron or zinc surface without peeling. It is applied by brush, roller, or spray, and can be painted over with enamels or other paint.



Boiler feed service motor redesigned

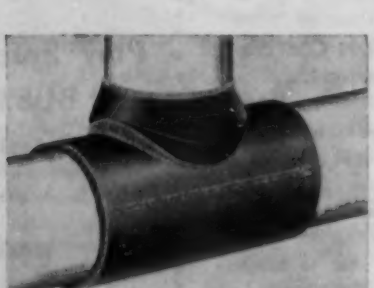
H30 Redesigned two-pole, 60-cycle, 3600-rpm squirrel cage motors in ratings of 900 hp and larger incorporate features particularly applicable to boiler feed service according to the manufacturer, Allis-Chalmers Manufacturing Co. The motors feature a completely new ventilation system, an improved oil seal, top air intake and discharge, and increased protection for the bearings.

TO REQUEST ADDITIONAL DATA

Circle "key" numbers on Reply Card between pages 34/35 & 90/91. Your requests will be handled promptly.

Purifier requires no maintenance

H31 Developed for keeping moisture and dirt out of air tools and other pneumatic equipment, Type LC Hi-eF Purifier is said to require no maintenance. Liquids and solids are drained automatically from the purifier by this company's float type trap. V. D. Anderson Co.

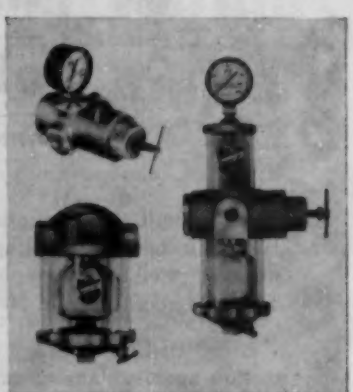


Unit offers full encirclement reinforcement

H32 To handle full encirclement reinforcement of branch connections, Bonney Forge & Tool Works has designed the Weldolet Split Tee. Assembled and ready for field installation, it meets service and size requirements from the smallest sizes to 30 in. outlets for run lines through 36 in.

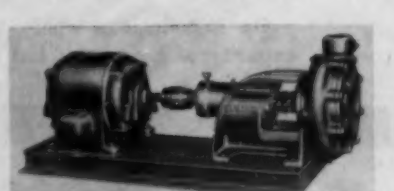
Dealkalizer designed for smaller plants

H33 For small and medium sized plants, the Cochrane Corp. Dealkalizer utilizes a strongly basic anion exchange resin capable of salt splitting and substituting chloride anion, for bicarbonate, carbonate, sulphate, and nitrate radicals. It is designed to provide custom-engineered systems at practically stock cost when used with this company's Zeo-Flo Softener.



Air control equipment offered as packaged unit

H34 Perfecting Service Co. announces a new line of Universal Air control equipment; air regulators, filters, lubricators, automatic drain traps, quick coupling connecters, and rotary air seals. The line includes a combination of the regulator, lubricator, and filter in one compact assembly requiring only two connections. Literature is available.



Pump has optional features for specific needs

H35 The Deming Co. end suction centrifugal pump (Fig. 4011 Series) is available with one to five in. discharge capacities up to 1000 gpm and maximum heads up to 250 ft. Units can be furnished with electric motor, for belt drive, or pump only. Bulletin gives performance information and tables.

Single valve controls air-oil ratio and capacity

H36 Series 620-P Vari-Pressure low pressure air type burners for oil or combination oil or gas are designed for multiple burner furnaces. Range of turn down and firing capacity is over 5 to 1 for sealed-in firing, and greater in open firing. Single valve control of

A guide to better flow metering

Here's a new fact-filled, technical booklet that tells you feature for feature how the new Hays electronic flow meter excels.

Electronic operation—provides maximum accuracy (¼% of full scale differential), and speed (4 seconds for full scale pen travel).

Mercuryless transmitters—rupture-proof metallic bellows for differential pressure measurement.

Continuous integration—motor-driven, continuous mechanical integrator is extremely accurate even on rapid load changes.

Other features include powerful motor, easy readability, accuracy unaffected by normal temperature changes, optional explosion and weather-proof transmitter.

Write for bulletin 54-1074-222 and get the important facts.

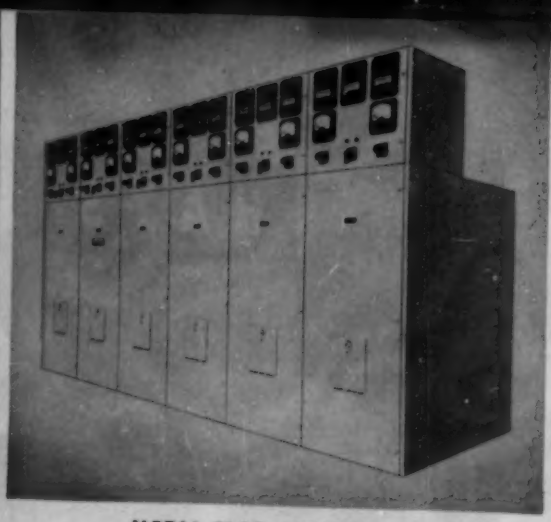
Automatic Combustion Control
Boiler Panels • CO_2 Recorders
Vacuflow Meters and Vertical
Gas Analyzers • Draft Gages
Combustion Test Sets
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

hays
CORPORATION

MICHIGAN CITY, 2, INDIANA

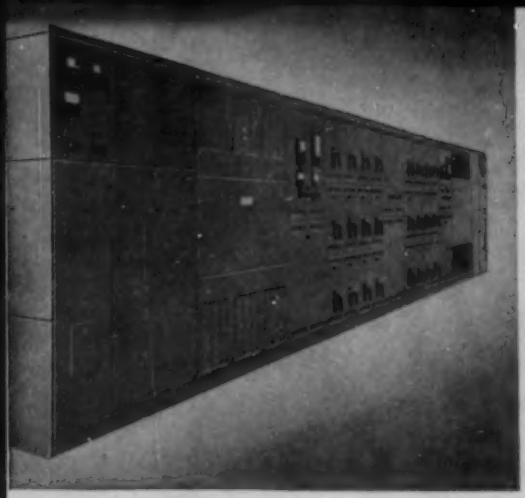
Circle 510 on Reply Card for more data

METAL-ENCLOSED BUS STRUCTURES



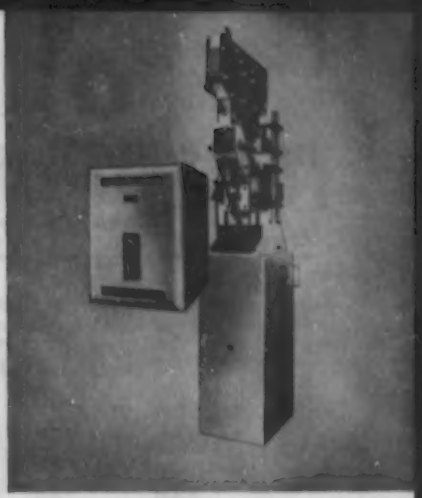
METAL-CLAD SWITCHGEAR

Put I-T-E



UNIT SUBSTATIONS

LOW-VOLTAGE SWITCHGEAR



LARGE AIR CIRCUIT BREAKERS

in your power plans...

for Dependability, Safety, and Over-all Economy

A complete line of Quality Switchgear Equipment

From generation to utilization, I-T-E quality equipment serves every industrial and commercial application. Whether your plans include bus structures, metal-clad or low-voltage switchgear, unit substations, or individual circuit breakers—you are assured of I-T-E's many *extra-service* benefits, which include:

1. selection and application of equipment
2. preparation of specifications
3. coordination of all job requirements

Power is fundamental in any new plant construction or expansion. Power distribution systems must be planned to assure maximum dependability of service, safety for personnel and equipment, and *over-all* economy—from initial planning . . . through the life of the equipment.

Furthermore, it is important to plan power systems with an eye to the future. They should be adaptable to changing plant requirements for many years ahead.

For these reasons, it pays to include I-T-E quality products in your power plans. For over 65 years I-T-E has set the standard for the industry—through engineering skill, design refinement, and introduction of new ideas and thinking.

For details, contact the I-T-E field office nearest you. Look in your classified telephone directory under "Electrical Equipment."

THE SYMBOL OF QUALITY SWITCHGEAR

I-T-E CIRCUIT BREAKER COMPANY

19TH AND HAMILTON STS. • PHILADELPHIA 30, PA.

SWITCHGEAR PRODUCTS

Circle 511 on Reply Card for more data

new equipment

—Starts on page 8

air-oil ratio and capacity is obtained with a control valve in the combustion airline serving a group of burners. Hauck Manufacturing Co.

Stem can be repacked under full line pressure

H37 Molded, globe-type polyvinyl chloride valves developed by Stokes Molded Products are for corrosive duty at medium pressures where the temperature does not exceed 160 F. The stem can be re-packed with Teflon packing under full line pressure and no packing of any type is necessary at the valve seat. Valves fit pipe sizes of ⅜, 1, and 1½ in.

Tape has wide-spread industrial uses

H38 Aluminum foil pressure-sensitive tape for industrial sealing, splicing, electroplating, conduction, and heat reflection jobs is announced by Minnesota Mining and Manufacturing Co. Called Scotch brand tape No. 425, it has a dead-soft aluminum foil backing coated with a high-tack thermosetting type adhesive. It is available in ¼ to 24 in. widths on 60 yd rolls.

D-c rectifier brakes available on a-c equipment

H39 D-c rectifier brakes are now available for ac-operated hoists and smaller capacity cranes. They are offered on type RP&H Hevi-Lift Hoist and Trav-Lift Crane manufactured by Harnischfeger Corp., and are known as the RCD Brake.

TO REQUEST ADDITIONAL DATA

Circle "key" numbers on Reply Card between pages 34/35 & 90/91. Your requests will be handled promptly.

Unit rolls tube joints to consistent limits

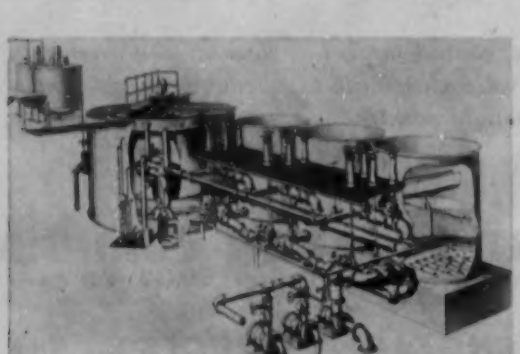
H40 Tube joints are rolled to maximum and consistent limits of tightness with automatic, electrically controlled equipment according to the manufacturer. The Airetool Mfg. Co. Two models for rolling tubes ¾ to 2½ in. I.D. are available, both utilizing the basic electrical control but differing in method of application. Known as the automatic Tube Expansion Control System, the units have a preset "Limit Control" which accurately measures the amount of current to the driving motor.

Floodlight mounts on flat base or arm brackets

H41 Crouse-Hinds Company's general purpose floodlight, type MDB-10, is now available with either flat base or suspension assemblies for installation on grounds or on elevated metal arm brackets. Tools are unnecessary to relamp the fixture since the lamp is removed and replaced by unlatching a single clamp and opening the hinge door. Either 300 or 200-w bulbs may be used.

Synthetic rubber V-rings are long-wearing

H42 Homogeneous V-rings, molded to J. I. C. accepted dimensional standards (corresponding to AN-6225 sizes) are available from the Packing Div. of Raybestos-Manhattan, Inc. in two types of synthetic rubber. Rings using Neoprene base compound are said to have low friction, low swelling, and high wear-resisting characteristics. Buna-N base compound rings meet the need for rings with high oil resistance, low friction, and high wear-resistance features.



Water treatment plant is completely integrated

H43 For economy-minded smaller communities, Graver Water Conditioning Co. is offering a compact and completely integrated package-type water treatment plant.

The heart of this low-cost plant is the Graver Reactivator, a cold-process water treating unit used for selective or simultaneous removal of turbidity, color, and organic matter; taste and odor; iron and manganese; and hardness from water supplies. Detention time is only 60 to 90 min. instead of the normal 3 to 6 hr.

Standard layouts for the complete plant are available in a wide selection of capacities from 0.1 to 2.0 mgd, special layouts being available for larger capacities. Operation is relatively simple, requiring part-time supervision by a non-technical operator.

ELECTRICAL CONDUIT

SEALTITE (TYPE U.A.) is approved by Underwriters' Laboratories, Inc. for use where exposed to moisture or mineral oils (up to 60C). See N.E. Code, Art. 351.

SEALTITE ELECTRICAL CONDUIT PROTECTS WIRING

against oil, grease, water, dirt, chemicals, corrosive fumes, salt spray, weather

SEALTITE* is a flexible *and* liquid-tight electrical conduit. It gives maximum protection to your wiring when it must connect moving parts, absorb vibration, follow machine contours, flex into U-bends, be easily maintained or be safeguarded between misaligned ports.

It is being used successfully in wet locations, in tunnels, power plants, steel mills, canneries, chemical industries and in many outdoor applications. SEALTITE comes in two types:

TYPE U. A.—UL-approved. Made with flexible galvanized steel core, positive ground and tough outer cover.

NOM. I.D. (Inches)	INSIDE DIA. (Inches) Min.	Max.	OUTSIDE DIA. (Inches) Min.	Max.	APPROX. INSIDE BEND DIA. (Inches)	EST. WEIGHT per hundred ft. (Pounds)
⅜	.484	.504	.690	.710	8	30.0
½	.622	.642	.820	.840	10	36.6
¾	.820	.840	1.030	1.050	13	48.2
1	1.041	1.066	1.290	1.315	18	87.7
1¼	1.380	1.410	1.630	1.660	21	116.5

TYPE E. F.†(Extra Flexible)—for machine tools and industrial equipment. (Meets standards set by J.I.C.) †Pat. Applied For

NOM. I.D. (Inches)	INSIDE DIA. (Inches) Min.	Max.	OUTSIDE DIA. (Inches) Min.	Max.	APPROX. INSIDE BEND DIA. (Inches)	EST. WEIGHT per hundred ft. (Pounds)
⅜	.485	.505	.690	.710	5	24.3
½	.620	.640	.820	.840	6	29.0
¾	.815	.835	1.030	1.050	9	38.2
1	1.025	1.055	1.290	1.315	10	65.0
1¼	1.365	1.395	1.630	1.660	13	84.4
1½	1.575	1.605	1.870	1.900	15	122.0
2	2.020	2.055	2.335	2.375	17	158.0
2½	2.480	2.515	2.840	2.875	20	205.0
3	3.070	3.110	3.460	3.500	27	290.0
4	4.000	4.050	4.460	4.500	34	430.0

Commercial tolerances apply on above figures.

ELECTRICAL WHOLESALERS stock both types. Buy it in long random lengths as shown; then cut without waste. Or ask your wholesaler to cut the length you need. Liquid-tight connectors are available from wholesalers' stocks. Write for Bulletin UA-531. *The American Brass Company, American Metal Hose Branch, Waterbury 20, Conn.*

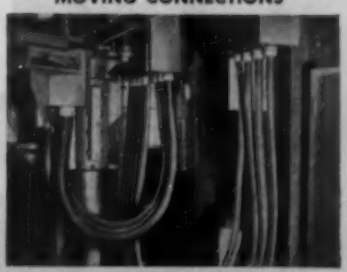
*Trade Mark

54175

SEALTITE flexible, liquid-tight electrical conduit as **ANACONDA®** product

FOR WET SPOTS

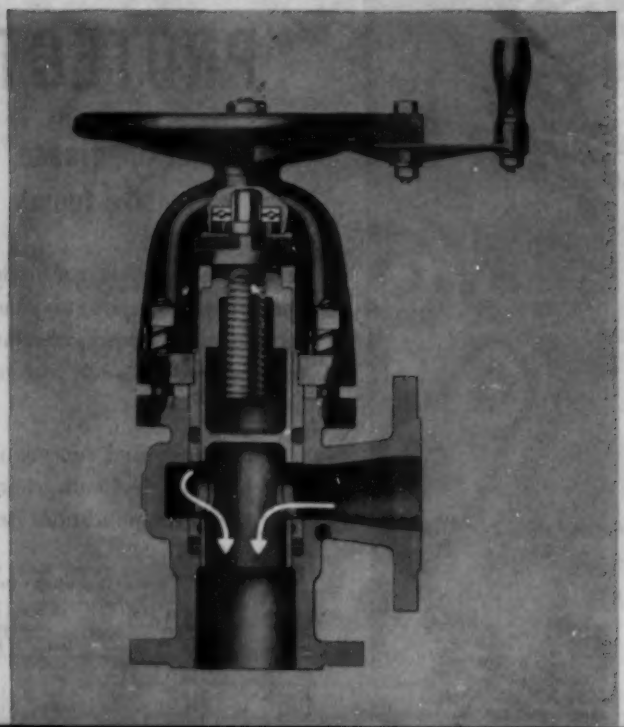
MOVING CONNECTIONS



OUTDOORS

MISALIGNMENT

These YARWAY VALVE DESIGNS



YARWAY SEATLESS

Features balanced nitralloy hollow plunger that seals line drop-tight, yet permits free, unobstructed flow in blow-down. Other features —laminated packing, alemite lubrication, ball thrust bearings. USED SUCCESSFULLY IN OVER 15,000 BOILER PLANTS.

FOR LOW and MEDIUM PRESSURES

YARWAY HARD-SEAT

Features tough, stellite-faced and ground disc and seat ring, mated to provide smooth long-wearing surfaces. Stream-line flow. Alemite lubrication. MORE THAN 4 OUT OF 5 HIGH PRESSURE BOILER PLANTS USE YARWAY BLOW-OFF VALVES.

FOR HIGHER PRESSURES

USED IN OVER 15,000 BOILER PLANTS

serve every boiler blow-down need

■ Whatever your *pressure* requirement, whatever your *piping* requirement—there's a Yarway Blow-Off Valve to exactly meet your needs.

Popular Yarway *seatless* design keeps blow-down lines drop-tight in low and medium pressure ranges. Sturdy Yarway *stellite seat and disc* design protects higher pressures.

All Yarway Blow-Off Valves are strong, rugged valves, built to withstand the punishment of regular or emergency blowing-down under full boiler pressure, and are available in metals that stand up under acid washing of boilers.

Write for new Yarway Blow-Off Valve Bulletins—B-426 (pressures to 400 psi) or B-434 (pressures to 2500 psi).

• Yarway Type B Seatless Blow-Off Valve, iron body for boiler pressures to 200 psi, steel bodies, for pressures to 400 psi. Angle valve shown, straightway available. Flanged connections. See Bulletin B-426.

• Yarway Type B Seatless Tandem Blow-Off Valve combining two angle valves. Other combinations available. Iron bodies for boiler pressures to 200 psi, steel bodies for pressures to 400 psi. See Bulletin B-426.

• Yarway Type C Seatless Tandem Blow-Off Valve combining angle and straightway valves. Other combinations available. Flanged or welding connections available. For boiler pressures to 600 psi. NOTE: When used in tandem with a Yarway Hard-Seat Valve, Type C Seatless may be used to 1500 psi. See Bulletin B-434.

LET YARWAY HELP SOLVE YOUR BOILER BLOW-DOWN PROBLEMS!

YARNALL-WARING COMPANY
109 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY

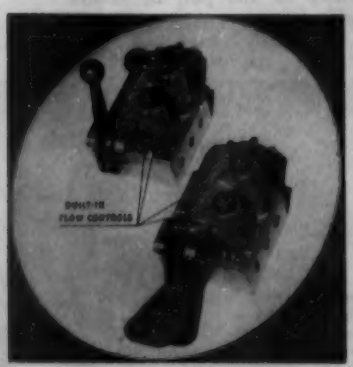
blow-off valves

Circle 513 on Reply Card for more data

new equipment

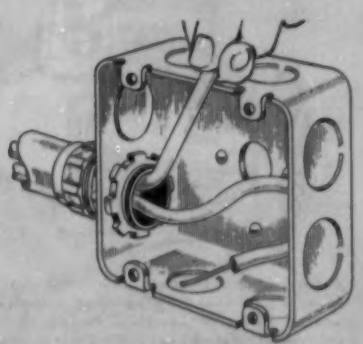
—Starts on page 8

low friction, and high wear-resistance features.



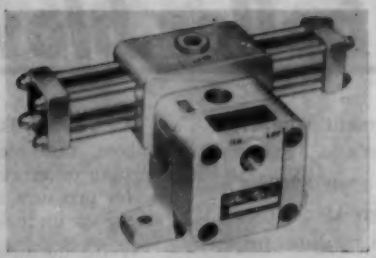
Valves control double-acting air or hydraulic cylinders

H44 Airmatic Valve, Inc. is introducing hand-and-foot operated four-way valves with patented built-in, full-capacity, flow-control meters of the Venturi type. Designed for the control of double acting air or hydraulic cylinders, the valves are built for heavy-duty service and long operating life. The basic valve can also be supplied for remote pilot operation, cam, single or double solenoid, together with time-delay features. Non-corrosive, it is available in ¼, ⅜, ½ and ¾ in. pipe sizes, for pressure ranges 0 to 150 lb.



Insulated throat connectors reduce installation cost

H45 Thin wall electrical metallic tubing conduit now can be installed at lower cost with a new all-steel, insulated throat connector according to the manufacturer, The Thomas & Betts Co. Approved by Underwriter's Laboratories, the device also complies with National Electric Code, which calls for smoothly rounded insulating surfaces at raceway terminations to protect wires inside. It is made in sizes to accommodate EMT conduit from ½ to 2 in. in dia.

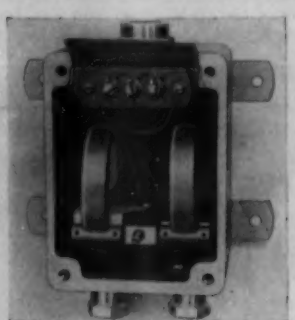


Valve design eliminates alignment problems

H46 Designed for actuating remotely located or automatically operated cylinders are two disc-type power operated valves announced by Ledeen Manufacturing Co. Available in two and three positions, these valves feature "free-floating" piston movement thus eliminating alignment problems. They are available as complete packaged units, and are built in sizes from ⅛ to 1¼ in. standard pipe connections.

TO REQUEST ADDITIONAL DATA

Circle "key" numbers on Reply Card between pages 34/35 & 90/91. Your requests will be handled promptly.

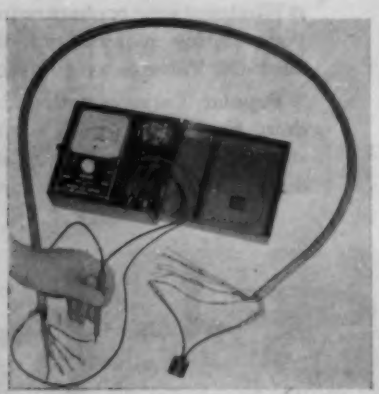


Pressure switch mounts in any position

H47 Available in four classes of proof pressures from 500 to 12,000 psi, Model 532 Meletron Pressure Switch senses a pressure difference between two variable pressures or a variable and a reference pressure. The switch permits opening or closing of a circuit on increasing or decreasing pressure difference from 15 to 10,000 psi at any point within the adjustable range of the model selected. It may be mounted in any position. Barksdale Valves.

Aluminum neoprene coating protects ferrous metals

H48 SEACO #342, an aluminum neoprene coating, has been developed by Chemical Coating and Engineering Co. for protection of ferrous metals against atmospheric corrosion including salt spray and fumes. It requires no separate activators, is self curing at normal room temperature, and can be tinted to give a wide range of metallic colors.



Meter identifies as many as nine wires

H49 One man instead of two can trace electrical lines and cable circuits with the Jackson Electrical Instrument Co. Trace-O-Meter. The meter will identify as many as nine wires. A neon indicator lights if the line is hot. The instrument also has a control to pre-set the meter in relation to electrical loss through the lines.

Pipe insulation available in wider size range

H50 Gustin-Bacon Manufacturing Company's Snap-On pipe insulation is now available in a new range of sizes, from ¼ to 24 in. dia for every type of industrial, commercial, or residential application. This one-piece molded glass fiber insulation has an unusually high thermo efficiency (K factor of 0.23 at 100 F mean). Literature and samples are available.

Air supply filter for pneumatic instruments

H51 A compact air filter, designed to prevent dirt, oil, water, and other foreign matter from entering pneumatic instruments, is announced

if you want lower V-Belt costs—

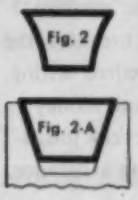
When a V-Belt bends, you can feel its sides change shape.

just make this simple test

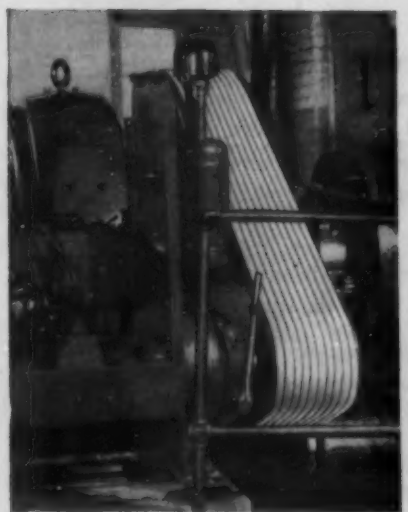
Take *any* V-belt that has *straight* sides (Fig. 1). Bend that V-belt while you grip its sides with your fingers. You will *feel* the sides *bulge out* (Fig. 1-A). Clearly, that out-bulge forces the belt to press *unevenly* against the V-pulley—and this *concentrates* wear at the points shown by arrows (Fig. 1-A).

Now bend a Gates Vulco Rope with CONCAVE SIDES (Fig. 2)

(U.S. PAT. NO. 1813698)



Instead of *bulging*, the precisely engineered CONCAVE SIDES merely *fill out* and become perfectly straight. This belt, when bent, *precisely fits* its sheave groove (Fig. 2-A). The sides of the Gates Vulco Rope press *evenly* against the V-pulley. Therefore, wear is distributed *uniformly* across the *full face* of this belt —resulting in *longer* belt life and *lower* belt *costs* for you!



Typical Gates Vulco Rope Drive —the Gates V-Belts are built with Concave Sides to insure longer belt wear.

When you buy V-belts, be sure to get the V-belt with the Concave Sides—the Gates Vulco Rope!

Gates VULCO ROPE DRIVES

REG. U.S. PAT. OFF.

Gates Engineering Offices and Jobber Stocks are located in all industrial centers of the United States and Canada, and in 70 other countries throughout the world.

THE GATES RUBBER COMPANY
DENVER, U.S.A.

CG-548

Circle 514 on Reply Card for more data

SPECIFY I-T-E SWITCHGEAR

FOR ▶maximum protection ▶maximum service continuity ▶maximum value

Switchgear is an *important* purchase. That's why you should investigate the many advantages of I-T-E quality equipment. They add up to a sound investment which pays yearly dividends in complete electrical protection and service continuity.

Maximum protection—I-T-E switchgear contains industry-proved air circuit breakers engineered for long, trouble-free performance.

Maximum service continuity—The OD-2 trip device provides true coordinated selective tripping for the most effective type of circuit protection.

Maximum value—The modern I-T-E switchboard incorporates, along with I-T-E breakers, the highest quality bus, instrument transformers, control wiring, and required accessories. And to save you time and money . . . to assure the best application of equipment to every job, I-T-E provides the maximum of individual engineering assistance.

Switchgear is truly an investment. Specify I-T-E, and receive extra dividends now and throughout the life of the equipment.

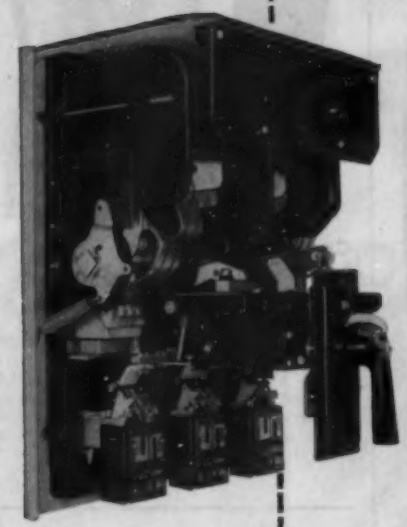
For details, contact the I-T-E field office nearest you. Look in your classified directory under "Electrical Equipment," or write for Bulletin 6004A.

THE SYMBOL OF QUALITY SWITCHGEAR

I-T-E CIRCUIT BREAKER COMPANY

19TH AND HAMILTON STS., PHILADELPHIA 30, PA.

Typical I-T-E low-voltage switchgear installation for modern, efficient control of power generators.



PROVED CIRCUIT PROTECTION

I-T-E air circuit breakers are sturdy, metal-base units with complete insulation of all current-carrying parts. The high-pressure silver contacts are strong, durable, and fast operating. Reliable contact action and efficient magnetic arc chutes assure positive interruption in a small space. Maximum flexibility, simplified testing and inspection are made possible by the horizontal draw-out feature.

COORDINATED "SELECTIVE TRIPPING"

This *direct-acting* OD-2 trip device isolates system faults by tripping only the breaker nearest the fault. The OD-2 is a compact, shock-resistant, sealed unit. "Dual selective," it offers precise long-time delay in seconds and minutes, and short-time delay in cycles.

ENGINEERED FOR SERVICE

The entire switchboard is carefully engineered to provide accessibility of components . . . safety for personnel . . . long life . . . ease of operation. Typical of its convenient design is the rear section with its full-height hinged doors. Rugged, structure-high frames eliminate the need for cross-bracing. Thus cable connections can be made simply and easily. Main horizontal bus is located deep inside the compartment—a construction feature which allows ample space for instrument transformers, bus duct, and cable connections. Generous-sized bus is braced to withstand maximum short-circuit conditions.

LOW-VOLTAGE SWITCHGEAR

Circle 515 on Reply Card for more data

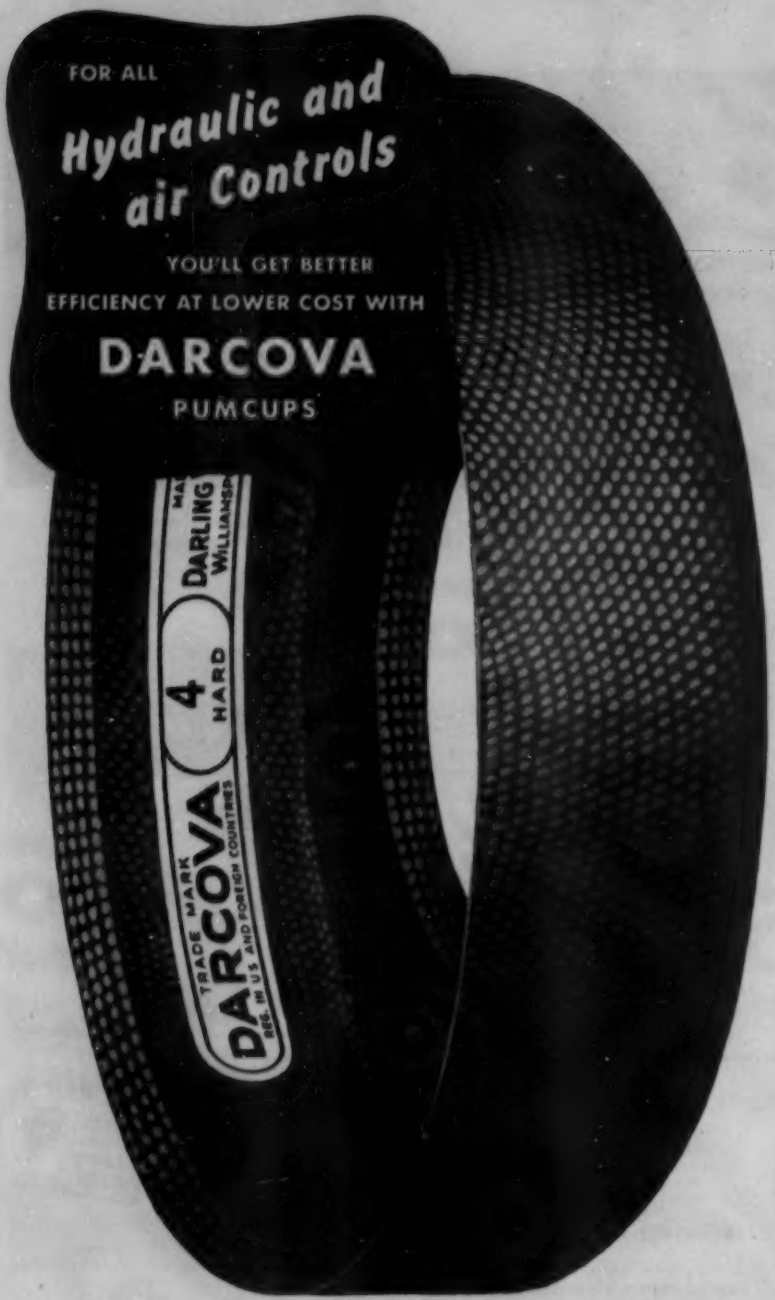
FOR ALL

Hydraulic and air Controls

YOU'LL GET BETTER EFFICIENCY AT LOWER COST WITH

DARCOVA

PUMCUPS



There's a free bulletin full of reasons and proof. Ask for it today!

DARLING VALVE & MANUFACTURING CO.
WILLIAMSPORT 9, PA.

DARCOVA
THE ORIGINAL COMPOSITION CUP

PUMCUPS

Circle 516 on Reply Card for more data

new equipment

—Starts on page 8

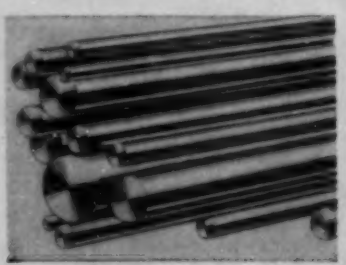
by the Foxboro Co. It removes particles as small as 40 microns and has a capacity of 4 cfm of air or natural gas. Sump capacity is 12 cu in.; filtering area, 21.2 sq in.; and maximum working pressure 150 psi. Technical report TI 29-A-92a gives complete information.

Capacitor line has wide range of ratings

H52 Weatherproof capacitors for outdoor or indoor application on 460 v distribution systems are announced by Westinghouse Electric Corp. All units are 3-phase, 460-v. Smaller unit is rated at 2 and 3 kvar; the larger at 4, 5, and 6 kvar. Flexible cable allows installation by direct or conduit connection.

TO REQUEST ADDITIONAL DATA

Circle "key" numbers on Reply Card between pages 34/35 & 90/91. Your requests will be handled promptly.

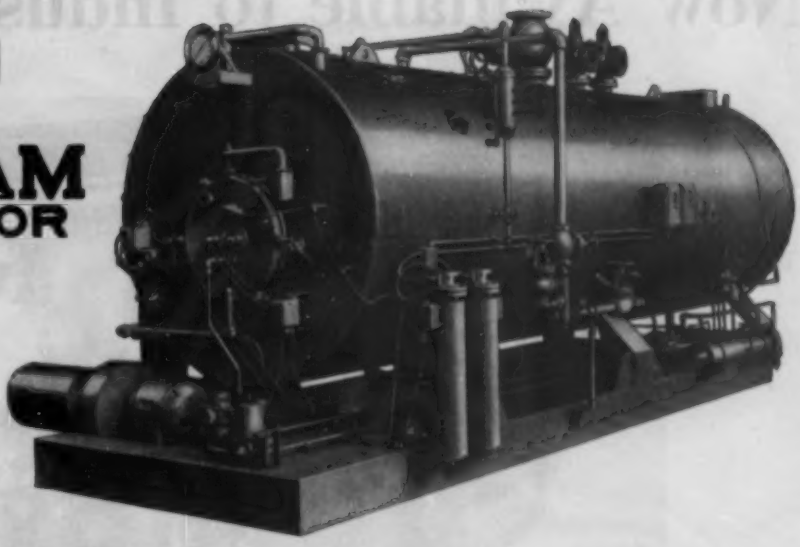


Steel bar stock can be machined in shop

H53 For repair or replacement use, La Salle Steel Co. is making available Stressproof bars. This steel is said to have the strength and wearability to replace practically any alloy or heat treated carbon steel bar, and can be machined by maintenance men on their own machines. The bars are

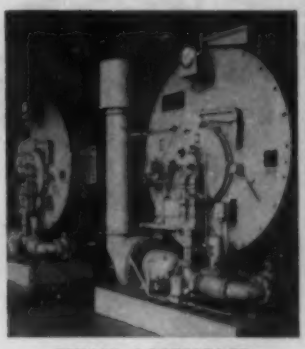
GET ALL THESE ADVANTAGES

WITH AN AMESTEAM GENERATOR



For:
PROCESSING
HEAT — POWER

20 sizes, 10 to 600 H.P., 15 to 200# W.P., oil, gas or oil-gas combinations with quick fuel switchover feature.



FULLY ASSEMBLED

All piping, wiring and operating parts completely assembled and tested at factory — units shipped in ready-to-fire condition!

EASY TO CLEAN

Ames-designed davit hinged flue covers and baffle provide quick and complete access to the furnace and all tubes.

SAVINGS IN FIRST COST!

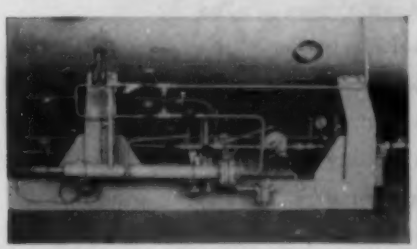
Your purchase price includes complete unit — no hidden "extras" to buy later on!

SAVINGS AT INSTALLATIONS

Just set on level concrete floor, connect to service lines and breeching. Nothing to assemble. No brick work required.

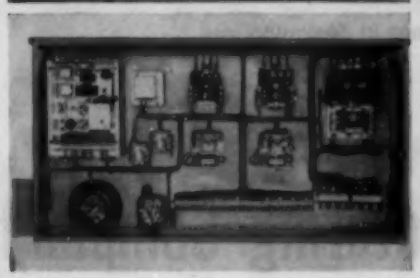
SAVINGS IN OPERATION

A minimum of supervision — lower manhour requirements for maintenance — easily replaced inexpensive plastic refractories — 80% thermal efficiency.



AMPLE ROOM

underneath for servicing auxiliary equipment. Control panel at eye level.



AUTOMATIC

operation, fully safeguarded, is provided by factory installed and tested control system.

Write for bulletin today!

AMES IRON WORKS, INC.
Oswego, N. Y., Box F-84

Gentlemen:

Please send me further information on AMESTEAM GENERATORS and name of nearest representative.

NAME.....

COMPANY.....

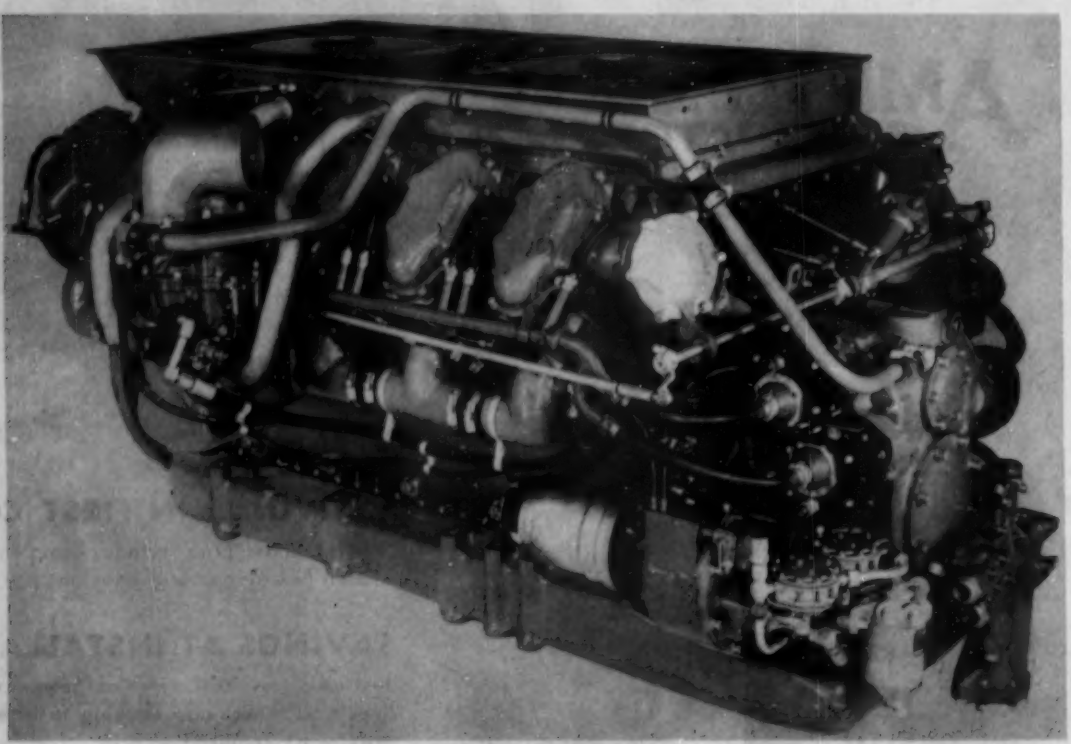
ADDRESS.....

AMES IRON WORKS INC.

BOX F-84 OSWEGO, N. Y.

Circle 517 on Reply Card for more data

New Army Air-Cooled Engine Now Available to Industry

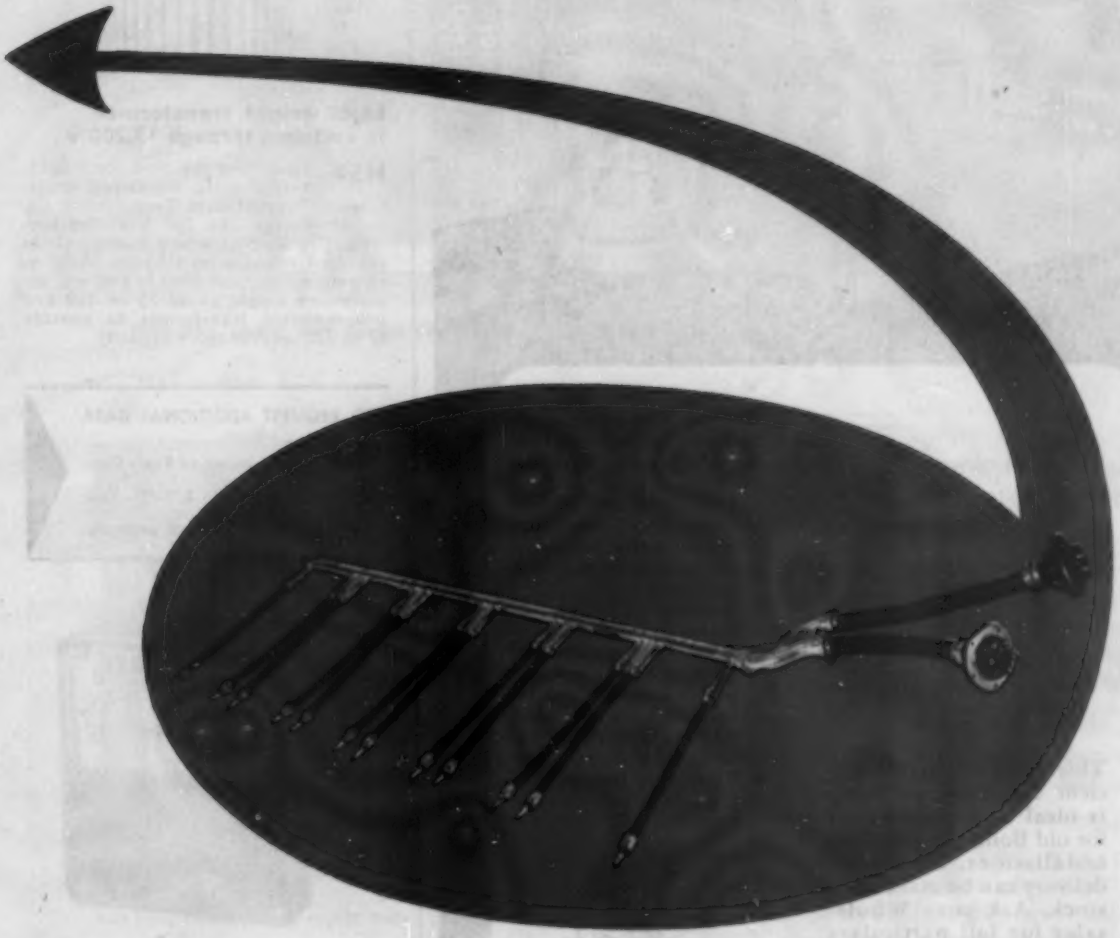


Continental Motors Corporation's 810 h.p. air-cooled engine pictured above, built for U. S. Army's famed General Patton tank, is one of a wide range of engines now available for heavy-duty commercial and industrial uses . . . The electrical wiring ignition harness, manufactured by National Electric, is a high voltage, radio-shielded system — rugged enough for combat — resistant to extremes of heat and cold — designed and built to operate under the most adverse conditions . . . National Electric also makes fine quality production harnesses for peacetime uses such as Automatic Clothes Washers, Dryers, Dishwashers and other home appliances . . . whatever your product—National Electric offers you more than a quarter century of experience in designing and producing fine electrical harnesses.

National Electric Manufacturing Company

High voltage ignition harnesses
Automotive chassis wiring harnesses
Home appliance wiring harnesses
Jet engine ignition harnesses
Switchboard panels
Control panels
Electrical timing mechanisms
Electrical temperature indicators
Automatic relay and switching devices

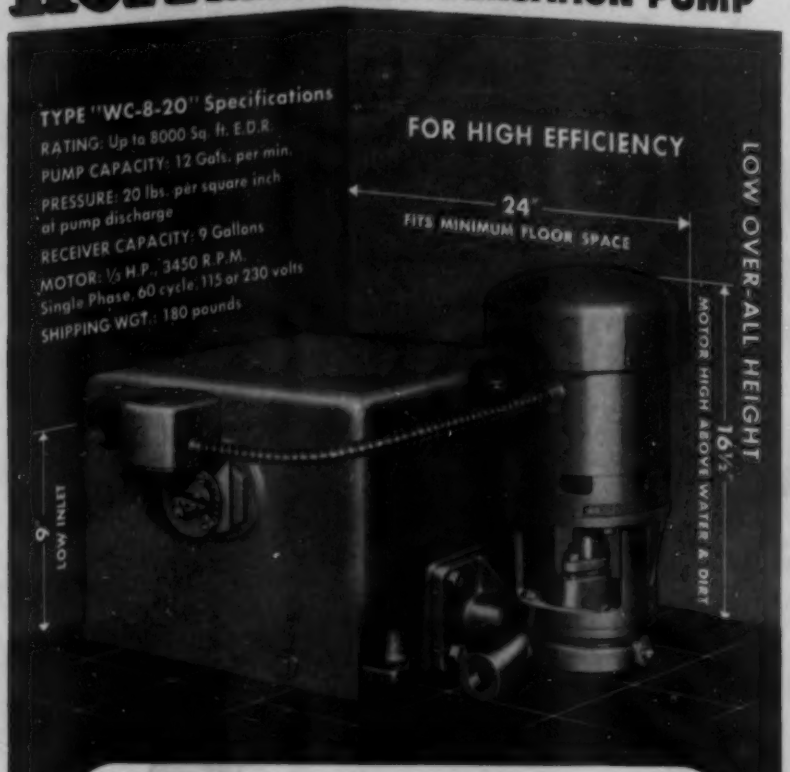
Electro-mechanical assemblies — manufactured to customers specifications

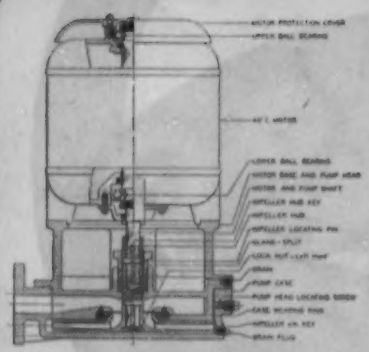


Niles, Michigan

Circle 519 on Reply Card for more data

HOFFMAN "WATCHMAN" CONDENSATION PUMP


TYPE "WC-8-20" Specifications
RATING: Up to 8000 Sq. ft. E.D.R.
PUMP CAPACITY: 12 Gals. per min.
PRESSURE: 20 lbs. per square inch at pump discharge
RECEIVER CAPACITY: 9 Gallons
MOTOR: ⅓ H.P., 3450 R.P.M. Single Phase, 60 cycle, 115 or 230 volts
SHIPPING WGT.: 180 pounds
FOR HIGH EFFICIENCY
24"
FITS MINIMUM FLOOR SPACE
LOW OVER-ALL HEIGHT
16½
MOTOR HIGH ABOVE WATER & DIRT
9
LOW INLET



This compact, highly efficient Condensation Pump is ideal as a replacement for old Boiler Return Trap installations. Immediate delivery can be made from stock. Ask your Wholesaler for full particulars with prices, or write for new Hoffman Condensation Pump Catalog CP-454, no obligation.

Here is a vertical, close coupled pump for low pressure heating systems, featuring:

1. One piece cast bronze centrifugal impeller dynamically balanced for smooth running and long life.
2. Receiver of heavy rust resistant cast iron.
3. All operating parts including motor and impeller assembly can be inspected or replaced without disturbing inlet or discharge piping.
4. Two pole heavy duty float switch easily adjusted.

HOFFMAN SPECIALTY MFG. CORP. 1001 York St., Indianapolis 7, Ind.

Makers of Valves, Traps, Hot Water Heating Systems, Vacuum and Condensation Pumps . . . Sold by Leading Wholesalers of Heating and Plumbing Equipment

Circle 520 on Reply Card for more data

new equipment

—Starts on page 8

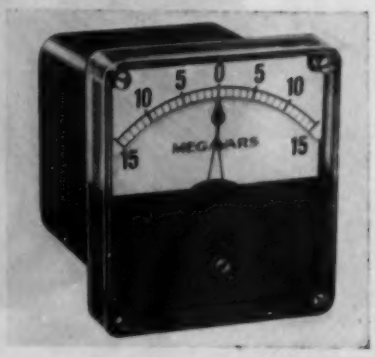
stocked in rounds from ⅜ through 3¼ in. and in hexagon from ⅜ through 2 in. and are said to be almost free from warpage.

Light-weight transformer in voltages through 13,200 v

H54 To answer the need for a light-weight pole-mounted transformer, Pennsylvania Transformer Co. is introducing the 167 kva "feather-weight" Pole Star which is available in standard voltages up through 13,200 v. It weighs less than 1500 lb and will replace any single phase 75 or 100 kva pole-mounted transformer to provide 67 to 123 percent more capacity.

TO REQUEST ADDITIONAL DATA

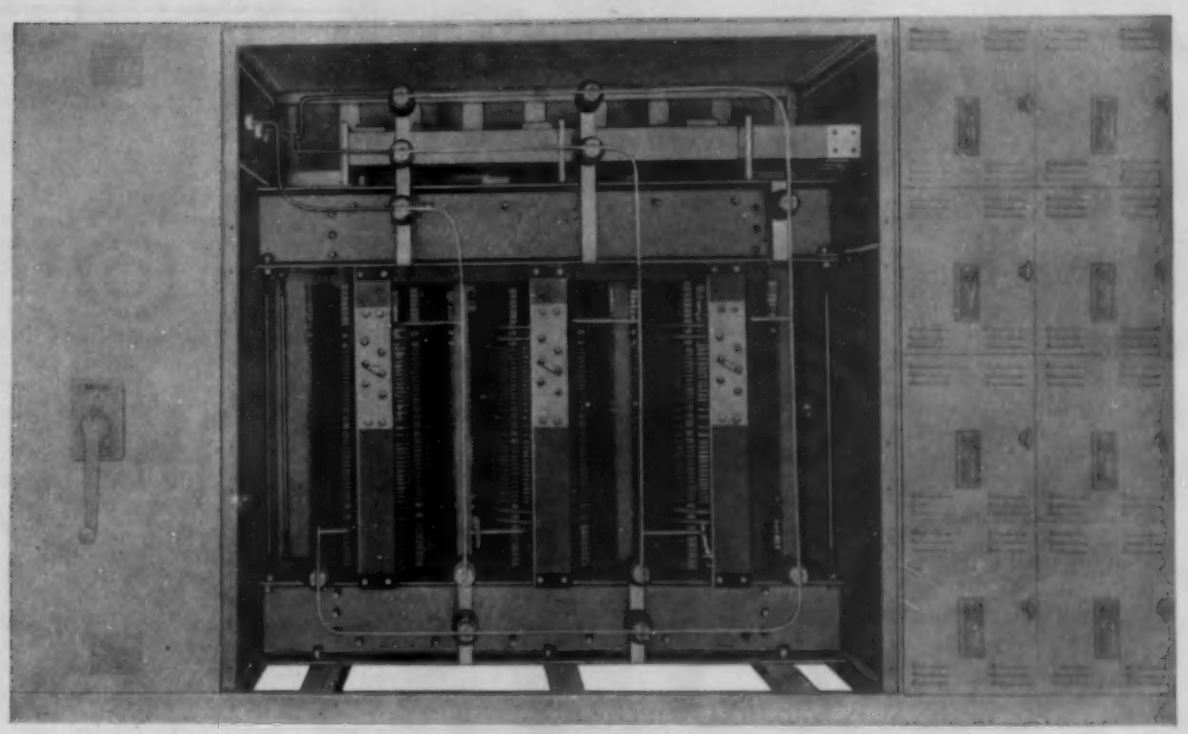
Circle "key" numbers on Reply Card between pages 34/35 & 90/91. Your requests will be handled promptly.



Plastic case eliminates need for internal illumination

H55 Clear plastic front 4½ in. switchboard and panel instruments announced by Weston Electrical Instrument Corp. have "in-line" pointers and dials. The plastic admits a maximum amount of light on the dial, thus eliminating need for internal illumination under normal operating conditions.

The transformer is the heart of a substation



1000 Kva 13,200 volt Sorgel dry-type transformer in a substation — (compartment panel removed)

500 Kva, 3-phase, 4160 to 480 Volt Askarel-cooled transformer, with primary and secondary throats

A substation is no better than its transformer; therefore, it is important that the transformer is of the best quality — a Sorgel transformer, either dry-type or Askarel-cooled.

Sorgel transformers are top quality, time tested, and are thus recognized and accepted by discriminating engineers and users. Their rugged construction assures continuous, reliable service. Their design is liberal. Efficiency is high. Quiet operation.

The Sorgel Electric Co. has 40 years of experience in the development, manufacturing and application of transformers.

Sorgel transformers, sizes 100 to 3000 Kva, all voltages up to 15,000 volts, either dry-type or Askarel-cooled, are procurable with any make or type of switch gear, and from any substation manufacturer.

Sales Engineers in Principal Cities

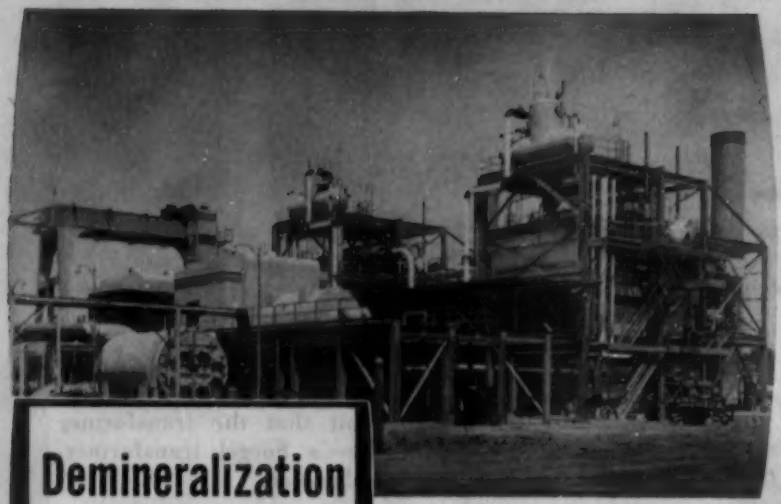
SORGEL ELECTRIC CO., 841 West National Ave., Milwaukee 4, Wis.

Pioneers in the development and manufacturing of Transformers—For 40 years

Circle 521 on Reply Card for more data

SMALL IN SIZE, BUT

big in importance



Demineralization
and
Silica Removal
equipment . . . in the above plant

is so small it can hardly be seen in this picture—yet the CATEXER® and ANEXER® ion exchangers provide the low silica, low solids boiler feed makeup water required for trouble-free high pressure boiler and turbine operation.

For more information, write for INFILCO Ion Exchanger Bulletin 1960-Y.

Send for this useful bulletin —no obligation

INFILCO

INFILCO INC. | *Tucson, Arizona*

Plants in Chicago and Joliet, Illinois

Field offices in 33 principal cities in the U. S., Canada and Mexico

Circle 522 on Reply Card for more data

letters

. . . from readers

The Smell's The Thing

Gentlemen:

Recently we came across an article which appeared in a Special Report on Industrial Waste Treatment put out by your magazine in June 1951, describing the treatment of textile bleaching and dyeing lace at the Chester Lace Mills, Chester, Pa.

This plant we understand has been shut down, and we are desirous of knowing if you have any other published articles pertaining to this subject.

Any advice you can give us will be greatly appreciated for we have been called upon by many lace manufacturing firms, particularly those located in Rhode Island, who have a problem of cleaning up their waste water from soaps and dyes. This waste water gives off, during extremely hot weather, a very bad odor; and the state of Rhode Island and the residents close to these lace mills are demanding that they treat this waste water, otherwise they will bring drastic action.

H. M. Mullen
Gale Separator Co., Inc.
New York City

—Mr. Mullen was referred to Mr. R. H. Souther, Director of Research at Cone Mills Corp., Greensboro, North Carolina, where some most interesting work has been done in this field.—Ed.

Aisle Widths

Gentlemen:

We desire to obtain a reprint of the article by John J. Sichman, which appeared on pages 69 through 71 of the March 1954 issue of INDUSTRY AND POWER. The article is entitled "How Trailability Determines Tractor-Trailer Aisle Widths."

L. C. Stilp
General Purchasing Agent
Kimberly-Clark Corporation
Neenah, Wisconsin

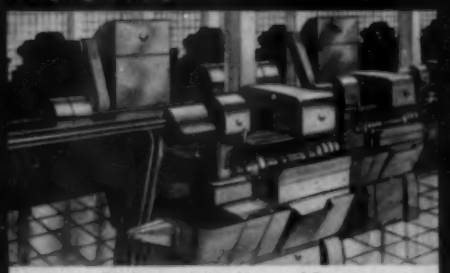
Light on the Subject

Gentlemen:

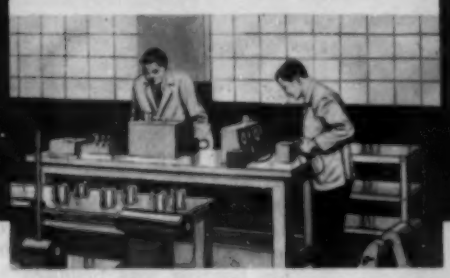
In your May 1954 issue of INDUSTRY AND POWER there appeared on page 63 a picture of a shear blade

V.V.T.* may be slowing up your production

*Varying Voltage Trouble shows up here:



. . . On Automatic Machines and Processes



. . . At the Inspection Bench — reference voltage and electric checking gear may no longer be "standard".

STABILINE Type EM4102

. . . ask your Electrical Engineer about STABILINE automatic voltage regulators!

Maybe only 1% of the power in your plant needs automatic voltage regulation, but that 1% can be of vital importance to effective production and quality control.

When rejects start plaguing you in automatic equipment or there is trouble in the inspection department, be suspicious of V.V.T.

If voltage regulation is required, install a STABILINE and you know your problems are over. STABILINES are the superior automatic voltage regulators designed to hold voltages constant for critical operations under the most exacting conditions.

STABILINE Automatic Voltage Regulator Type EM feature:

1. Available in 115, 230, and 460 volt ratings for single and three phase duty in capacities up to 100 KVA.
2. Zero waveform distortion.
3. Correction speed from .075 to .32 seconds per volt.
4. High efficiency comparable to fixed-ratio transformers.

Write for details, and be sure to see Superior Electric's Mobile Display when it is in your area.

THE SUPERIOR ELECTRIC COMPANY

2108 CLARKE AVENUE, BRISTOL, CONN.

Manufacturers of: Powerstat Variable Transformers • Stabiline Automatic Voltage Regulators • Voltbox A-C Power Supplies • Powerstat Light Dimming Equipment • Varicell D-C Power Supplies • Superior 5-Way Binding Posts

THE SUPERIOR ELECTRIC COMPANY
2108 Clarke Avenue, Bristol, Conn.

Please send STABILINE Bulletin S351.

Name.....

Position.....

Company Name.....

Company Address.....

City.....Zone.....State.....

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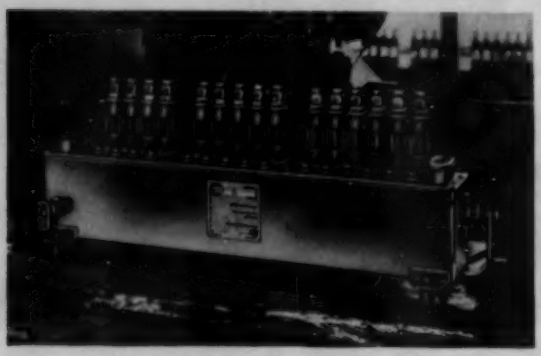
IS DOWNTIME UPPING YOUR COSTS?

CUT IT WITH MANZEL FORCE FEED LUBRICATION

Pressure Application—Exact Amounts—Accurately Timed



Because they operate automatically—dependably lubricating vital parts without thought or attention whenever machinery is running—Manzel Force Feed Lubricators eliminate costly shut downs for hand oiling and for repairs necessitated by faulty or neglected lubrication. They save labor and lubricants, too.

To keep costs down and production up, keep machines running with Manzel Force Feed Lubricators. They can be installed on machinery you are now using or incorporated into new equipment. For information write:

Manzel

DIVISION OF FRONTIER INDUSTRIES, Inc.
320 BABCOCK STREET, BUFFALO 10, NEW YORK

Circle 524 on Reply Card for more data

letters

—Starts on page 34

with six lamps mounted so that the light is directed through the slots along the edge of the blade.

I am interested in finding out what plant the picture was taken in because of the set up of the lighting system that has been used over this type of machine. We have a machine here at our plant that uses the same type of lamps but we find that vibration from the machine continues to break the lamps. The picture in your magazine shows the lamps mounted in a different manner so that they would not break the lamps.

A. W. Calder, Jr.
B-I-F Industries, Inc.
Providence, Rhode Island

—Mr. Calder's letter was forwarded to General Electric Co. whose reply was "The lamps . . . are Par-38, 150-w spot lamps. These are all mounted along a length of channel. The important part of this mounting is the fact that the channel is mounted to the machine itself with two formed steel connectors with a shock absorbing spring in between. This lighting was installed in the Kasle Steel Corp. in Detroit, Mich. Perhaps they can give you more detailed information about their lamp performance for this lighting application."

Gentlemen:

Please advise where I may secure further information regarding lighting facilities for welders without lifting their mask as described in the article "Extra Light for Critical Seeing" by E. A. Linsday, Application Engineering Department, General Electric Company.

William H. Wiggins
Hedstrom Union Co.
Dotham, Alabama

—General Electric's answer to this was: "The problem . . . is primarily one of providing a very high lighting level. The light transmitted through the glass used in welders' masks and reflectivity of the work itself will determine amount of light necessary. The unit shown . . . uses three 300-w R-40 reflector spot lamps which provide about 1500 foot-candles on the work and is operated from a foot switch so that the welder can turn it off as soon as the arc is struck."

DETROIT ROTOSTOKER TYPE C-C *(continuous cleaning)*

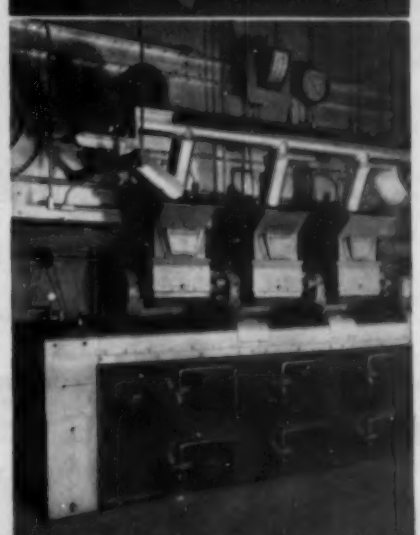
Makes a Hit WITH ENGINEERS

They're buying Detroit RotoStokers Type C-C because of these exclusive features:

- Cleans Fuel Bed and Discharges Ash Continuously at the Front
- Smokeless Operation Through Wide Load Range
- Efficiently Burns Bituminous Coals and Lignite
- Insures Continuous uninterrupted Steaming Capacity and High Availability
- Responds Quickly to Fluctuating Loads
- Fuel Feeders Handle High Moisture Coals Easily and Without Clogging
- Operation Automatic and Dependable
- Easily Applied to Existing Boilers—No Basement required
- Design Results in Low Maintenance
- Sizes Available to Develop from Approximately 5,000 to 75,000 Pounds of Steam Per Hour

DETROIT ROTOSTOKER TYPE C-C

6879



Detroit RotoStoker Type C-C (continuous cleaning) installed or ordered for Steam Plants of:

Allied Chemical & Dye Corporation
Alpena Power Company
Auto-Lite Battery Corporation
Columbian Carbon Company
E. I. DuPont de Nemours & Company, Inc.
Frankenmuth Brewing Company
General Motors Corporation
Motor Products Corporation
National Gypsum Company
State of South Dakota
U. S. Atomic Energy Commission
U. S. Steel Corporation
Wake Forest College
Walter Brewing Company

DETROIT STOKER COMPANY

GENERAL MOTORS BLDG.
DETROIT 2, MICH.
Works at Monroe, Mich.
District Offices in Principal Cities

Circle 525 on Reply Card for more data

new bulletins

. . . catalogs from leading manufacturers

200—Electrical Controls

Redesigned for easy reference, catalog 54 commemorates this company's fortieth anniversary in the steam and electrical control field. With the description of products are included quick reference tables on pressure and temperatures, water heads, equivalent pressures. O. C. Keckley Co.

201—Heavy-Duty Compressors

Complete information on construction and operation of the series 100, Class WN-114 heavy-duty air compressors for industry are given in 36-page bulletin A-72. Illustrated are seven single-unit models for displacement capacities from 1186 to 1948 cfm as well as twin units which furnish up to 3896 cfm. Joy Manufacturing Co.

202—Torque Limiters

Design and operational information, as well as specification tables for a line of eleven standard models of torque limiters, are given in eight-page bulletin C14-54. Specialized adaptations of limiters in combination with flexible couplings and other devices are shown. Morse Chain Co.

203—Squirrel-Cage Motors

Designed to help in quickly choosing squirrel cage induction motors, both the new and current lines, 12-page bulletin B-2102 will prove to be a handy reference guide. It gives information essential to ordering the right motor for the job. Reliance Electric and Engineering Co.

204—Clutch Coupling

Dimensional data, service factors, and all other application engineering data necessary to specify the right clutch-coupling unit are given in this four-page booklet. Formaprag Co.

205—Thermometers

To aid you in selecting the right thermometer for your application, engineering specifications and illustrations of this company's standard line are presented in 14-page catalog 101. Included are complete specifications on the new Multi-Angle. United States Gauge Div. of American Machine and Metals, Inc.

206—Dry-Type Transformers

Dry-type air-cooled transformers described in 16-page bulletin H-10-101 are for industrial and commercial lighting and power circuits. Suggestions for the proper applications of these units and schematic diagrams make this a handy reference manual. Harrison Transformer Corp.

207—Water Level Controls

Twenty-four-page booklet SC-5, a revised edition, contains complete engineering information including capacity curves and roughing-in dimensions of boiler feeders, low water cut offs, pump controllers, and relief valves. Parallel data on different models is arranged in tabular form for comparison. McDonnell & Miller, Inc.

208—Valve Comparison Chart

This valve comparison chart lists valve figure numbers of 15 major manufacturers and this company's equivalent valve figure numbers. It compares gate, globe, check, and angle valves in bronze, iron, cast steel, and forged steel. Ohio Injector Co.

209—Mechanical Drive Turbine

Design features and proper control of the Type YR mechanical drive turbine are discussed in 16-page bulletin H-22. Modifications, specifications, and dimensions are detailed. Elliott Co.

210—Mixed Bed Demineralizing

"Automatic Mixed-Bed Demineralizing at the Albany Steam Plant," eight-page bulletin 3903 tells the story of the first fully automatic mixed-bed equipment to produce make-up water. A table shows the comparitive cost of an evaporator plant and a demineralizer. The Permutit Co.

211—Tank Calculator

Hydro-pneumatic tank calculator tells you instantly the best air-water ratio, most efficient pressure differential, exact amount withdrawn on any pressure drop, and resultant reserve. Printed on heavy board, the calculator operates on a slide rule principle. Automatic Control Co.

212—Graphitization

"Graphitization," a report on a ten-year study, discusses the problem from a standpoint of temperature, chemical composition, deoxidation practice, and stress and strain. Photographs and drawings illustrate structural formations of steel and relationship to graphitization. Edward Valves, Inc., subs. of Rockwell Mfg. Co.

213—Centrifugal Pumps

Easy maintenance and the many service features of the general service centrifugal pump are stressed in four-page bulletin 1001B. A full-page cut-away diagram shows design and construction of major parts. De Laval Steam Turbine Co.

214—Power Transmission

Eight-page foldout describes a new concept of power transmission — the Poly-V Belt Drive. This drive is said to be a solution to matching problems and to provide greater changeability. Manhattan Rubber Div. of Raybestos-Manhattan Inc.

215—Electric Control Centers

How to improve the installation of controls for heating, ventilating, and air conditioning with automatic electric Control Centers is clearly explained in six-page booklet F 5265-1. Wiring diagrams are used to compare the simplicity of this system with a standard electrical control layout. Barber-Colman Co.

216—Repair Cements

Text and illustration in this 48-page handbook present repair methods for leaks in pipes, boilers, radiators, concrete, cinder blocks, and sheet and plate metal. Directory describes the 12 repair cements and the jobs they will do. Smooth-On Mfg. Co.

217—Pressure Pipe Coupling

Ring-Tite, the new coupling for Transite Pressure Pipe, is the subject of six-page folder TR-142A. It shows how the coupling goes together, points out installation time savings, and explains economies in service. Johns-Manville Corp.

218—Fireclay Bricks

Two super-duty fireclay bricks — Alamo and Varnon — are discussed in eight-page bulletin ED-C. Booklet includes technical details, application information, property charts. Harbison-Walker Refractories Co.

219—Heavy-Oil Burner

Fuel savings is the theme of eight-page foldout AD-131 which describes the new "4" Hev-E-Oil burner. Illustrations show compactness and simplicity of design. Cleaver-Brooks Co.

220—Blowoff Equipment

High pressure practice and high rates of evaporation have greatly increased the amount of boiler blowoff required according to 11-page bulletin 2301A. How this automatic continuous blowoff equipment successfully meets demands of modern boilers is explained. The Permutit Co.

221—Aluminum Tubes

"Alcoa Aluminum Heat Exchanger Tubes," presents the complete story on aluminum heat exchanger tubes, emphasizing factors that provide a combination of low cost and corrosion resistance. This 24-page booklet was designed to be a basic reference source for engineers. Aluminum Company of America.

222—Plug Valves

Lubricated plug valves in full-port and venturi types are shown in 24-page reference book 39-5. Engineering information includes principal dimensions, types of control, metals, and lubricants. Homestead Valve Mfg. Co.

223—Ball Valves

Manually operated ball valves for water works and industrial applications are discussed in eight-page booklet 159-G. Large

NOTE — Each new bulletin item has a key number for your convenience in asking for a free, personal copy. Circle key numbers on Reply Card between pages 34/35 & 90/91.

Solve Distribution Problems
with SORGEL Substations and Power Centers

"Packaged" Units for Indoor Installations

Speeds Expansion and Earlier Production. The complete Substation is shipped in one or more factory-assembled units, on a substantial steel base, completely wired and tested, ready for installation and final connection. No need of buying separately the transformers, switches, fuses, insulators, circuit breakers, and other accessories, and then assembling and connecting them on the job.

Flexibility for Future Conditions. Being all self-contained in a single unit, the Substation can be readily moved from one location to another.

Saves Copper. The Substation can be placed near the load center, so that shorter secondary cables and smaller primary lines can be used. Improved voltage regulation and reduced line drop.

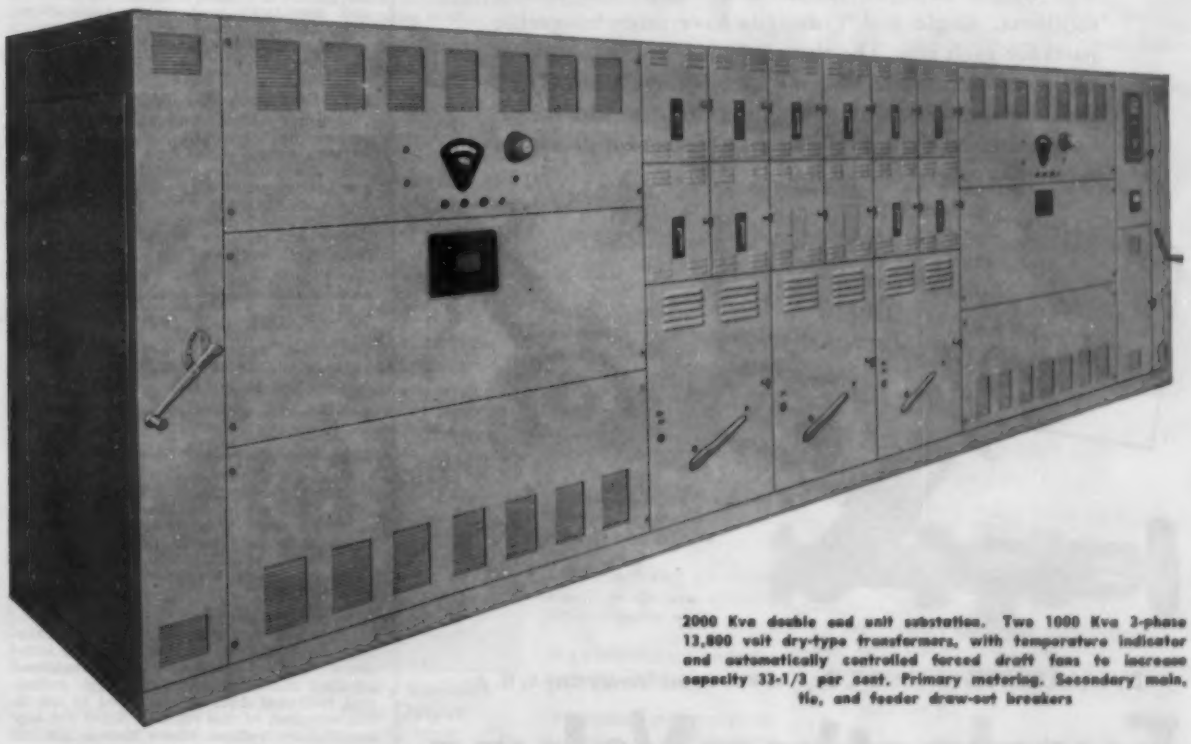
Reduces Costly Power Interruption. By locating the Substation at or near the load center, it restricts the power interruption to that area. Other areas, not affected, can continue operation.

Years of Continuous Hard Service. The rugged construction, liberal design, expert craftsmanship, sound engineering, all embodied in SORGEL transformers, have given years of continuous severe service.

Types. Either dry-type or Askarel-cooled transformers are available with any type or make of switchgear.

Engineered to meet your exact requirements

Sizes up to 3000 Kva. All voltages up to 15 KV.



2000 Kva double end unit substation. Two 1000 Kva 3-phase 13,800 volt dry-type transformers, with temperature indicator and automatically controlled forced draft fans to increase capacity 33-1/3 per cent. Primary metering. Secondary main, tie, and feeder draw-out breakers

Sales Engineers in Principal Cities

SORGEL ELECTRIC CO., 841 West National Ave., Milwaukee 4, Wis.

Pioneers in the development and manufacturing of Transformers—For 40 years

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For BOILER BLOW-OFF Safety

Standard Quick-Operating Everlasting Valve

Everlasting Y Valve

Everlasting Angle Valve

These Everlasting Valves are assuring safety in boiler plants all over the country. Each type is stoutly built, with ample strength, resistance to wear, and lasting tightness. Angle and Y designs have interchangeable parts for each size. The three types can be arranged in any combination as Duplex Boiler Blow-Off Units. All Everlasting Boiler Blow-Off Valves conform with ASME Codes, and are available in a range of sizes for pressures up to 600 psig.

Two of the many available combinations of **EVERLASTING** *Duplex Boiler Blow-Off Units*

Write for descriptive Bulletin

EVERLASTING VALVE CO., 41 Fisk Street, Jersey City 5, N. J.

Everlasting Valves

TRADE MARK EVERLASTING REG U S PAT OFF

EV302

for everlasting protection

Circle 527 on Reply Card for more data

new bulletins

—Starts on page 38

front view and sectional assembly drawing, with descriptions of standard settings, sectional assembly, and principal parts lists, make this a handy reference book. *Y.* Morgan Smith Co., Valve Div.

224—Heavy-Duty Fans

Heavy duty fans (Series 2000) for induced draft service are described in detail in eight-page catalog 1380. Included are maximum wheel speeds, total pressures, and volume ranges for three size classes. Power savings possible with use of optional inlet damper control are discussed. Westinghouse Electric Corp., Sturtevant Div.

225—En Masse Conveyor

This bulletin explains how an enclosed endless chain, fitted with specially designed flights, conveys such free flowing materials as grain, resins, fine chemicals, pigments, and pulverized materials in vertical, horizontal, or inclined planes. It includes dimensioned engineering drawings and an isometric cut-away section of a vertical run of the Flowmaster en masse conveyor. Gifford-Wood Co.

226—Air Circuit Breakers

Bulletin 5107-DR-1 contains four pages of facts, figures, features, and photographs on types KA, KB, KC, and LG Urelite air circuit breakers, and on weatherproof and dust-tight enclosures. Applications, specifications, and construction details round out contents of booklet. I-T-E Circuit Breaker Co.

227—Frequency Recorder

Instrumentation data sheet 9.1-8a describes the ElectroniK Frequency Recorder with a new pulse type measuring circuit. Designed for central stations, the recorder requires only one line connection to supply both the instrument power and the frequency source to the pulse converter and voltage bridge. Minneapolis-Honeywell Regulator Co., Industrial Div.

TO REQUEST FREE BULLETINS

Circle "key" numbers on Reply Card between pgs. 34/35 & 90/91. Your requests will be handled promptly.

228—Electric Power Drives

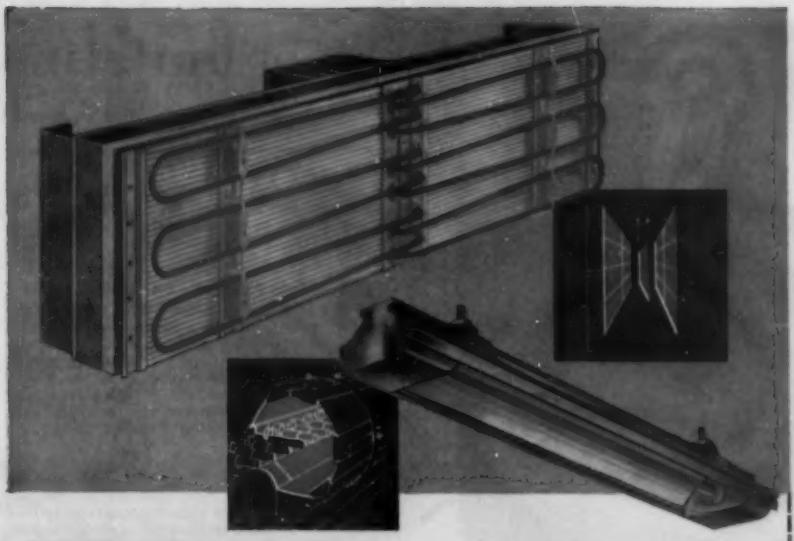
Eight-page bulletin 50M presents application stories and photographs of electric power drives on machinery and equipment of many kinds. Booklet is divided by industry: food, metal, chemical, petroleum, plastic, paper, printing, lumber, and textile. Sterling Electric Motors, Inc.

229—Switch Data

"Switches for Industry," 20-page catalog covers 22 "families" of switches, actuators, and enclosures. Dimensionalized photos, characteristics, electrical rating, and technical data are intended to aid in the selection of the right switches for any specific application. Micro Switch Div. of Minneapolis-Honeywell Regulator Co.

230—Motor Starters

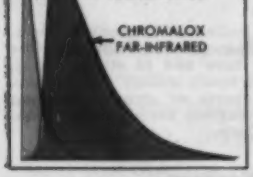
Motor starters having short circuit protection for 2200 to 5000 v systems are described in booklet 1062. Valimitor starters, which will safely interrupt the circuit from a bus of unlimited capacity, and



CHROMALOX
Far-infrared
solves hundreds of heating problems

Here's your quick, economical and easy solution for curing, drying, degreasing, dehydrating, baking and other heating jobs. Pre-engineered Chromalox Units make oven building as simple as A-B-C, generate uniformly absorbed far-infrared heat for a multiplicity of processing needs. Temperatures up to 700° F. are easily selected, accurately maintained. Low initial cost, low write-off cost, low operating cost!

ONLY CHROMALOX GIVES YOU ALL THESE ADVANTAGES

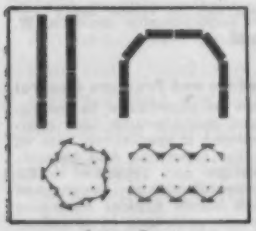


Color Blind Radiation

Longer far-infrared wave lengths are absorbed efficiently by all colors and textures.

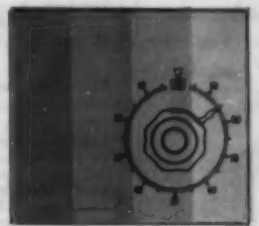
Heat Without Hot or Cold Spots

Chromalox radiant energy goes to work in a uniform pattern to span widest conveyor.



Low-Cost Oven Assembly

Pre-engineered Chromalox units require minimum expense to erect into complete ovens.



Infinitely Variable Heat Output

Heat from 0 to 100% of capacity to fit the exact temperature needs of the work.

plus

- **SHATTERPROOF CONSTRUCTION**—nothing to break or contaminate the work in process.
- **NON-DIMINISHING OUTPUT**—with all-metal Chromalox tubular far-infrared generators.
- **HIGH INTENSITY RADIATION**—with top BTUs per square foot.
- **QUICK HEAT-UP**—with energy transformed instantly into heat on the work.
- **ADDITIONALLY SAFE**-for any work involving volatiles.
- **MINIMUM MAINTENANCE**—Because of metal-sheathed, shock-resistant, long-lasting Chromalox tubular generators.

CHROMALOX *Electric Heat*
FOR MODERN INDUSTRY

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available to you on
APPLICATIONS OF CHROMALOX RADIANT HEAT

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ASPHALT
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- ☐ R-105: Heating Asphalt to Improve Sealing of Batteries
- ☐ RP-203: Drying Asphalt Tile

AUTOMOTIVE
- ☐ R-126: Drying Tractor Parts
- ☐ R-118: Baking Synthetic Enamel on Gasoline Engines Also see: Paint Baking

BATTERY
- ☐ R-105: Heating Asphalt to Improve Sealing of Batteries

BOTTLING (see Glass)

CERAMICS
- ☐ R-115: Drying a Water-Base Glaze on Ceramic Tile
- ☐ R-134: Preheating Dinnerware to Prevent Warping
- ☐ R-137: Drying Pottery

CHEMICALS (see Plastics)

COMFORT HEATING
- ☐ L-1077: Keep Men Warm, Keep Work on Schedule
- ☐ R-114: Comfort Heating for a Foundry Worker

DEGREASING
- ☐ R-116: Vaporizing Oil from Sheet Metal Parts Also see: Paint Baking

DRUGS (see Glass)

ELECTRONICS
- ☐ R-109: Drying Cement Base in Television Tubes

FINISHES (see Paint Baking, Degreasing)

FOUNDRY
- ☐ L-1060: Skin Drying of Molds
- ☐ L-1085: Core Drying
- ☐ L-1096: Shell Molding Goes Automatic
- ☐ R-113: Comfort Heating for The Foundry Worker
- ☐ R-130: Drying Precision Plaster Molds
- ☐ R-133: Shell Molding

GLASS
- ☐ C & R-2: Sterilizing & Preheating Bottles
- ☐ R-127: Heating Television Tubes to Bake Interior Graphite Coating

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- ☐ L-1064: Drying Lacquered Metal Parts
- ☐ L-1065: Improves Enamel Baking Five Ways
- ☐ L-1066: Bakes Big Parts or Small, Fast or Slow
- ☐ L-1080: Baking Paint on Radiators
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- ☐ R-119: Baking Paint on Metal Awnings
- ☐ R-131: Baking Paint on Meter Parts
- ☐ R-138: Drying Ink and Paint on Toothpaste Tubes

PAPER
- ☐ R-134: Drying Glued Paper Sheeting

PLASTICS
- ☐ L-1086: Drying Vinyl Coating on Imitation Leather
- ☐ L-1091: Post-Forming Formica
- ☐ R-101: Molding Kapok Center for Softballs
- ☐ R-102: Drying Plastic Powders
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- ☐ R-121: Dehydrating Vinyl Sheets
- ☐ R-123: Drying Plastic Laminates
- ☐ R-128: Curing Plastic Coating on Spring Clips
- ☐ R-129: Fusing Vinyl to Chip Board
- ☐ R-132: Embossing Vinyl
- ☐ RP-210: Heating Plexiglas for Vacuum Forming
- ☐ RP-202: Heating Thermoplastic for Vacuum Forming

PRINTING
- ☐ L-1090: Silk Screen Process Drying
- ☐ R-103: Static Removal
- ☐ R-107: Drying Ink on a Miehle Vertical Press
- ☐ R-108: Ink Drying on 8-Unit Web-Fed Offset Press
- ☐ R-110: Eliminating "Offset" on Duplicating Machines
- ☐ R-124: Drying Ink on a Goss Press
- ☐ R-136: Silk Screen Process Drying

REFRIGERATION
- ☐ L-1055: Dehydrating Refrigerator Coils

RESTAURANT
- ☐ Far-Infrared Food Warmer

RUBBER
- ☐ L-1056: Curing Latex Foam Sponge Rubber
- ☐ R-125: Cementing Crepe Rubber to Wooden Soles

TEXTILES
- ☐ L-1068: Fusing Vinyl to Cloth Work Gloves
- ☐ R-112: Dehydrating Braiding Material

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TEMPERATURE RECORDING...

Newly designed, Model "1000" Auto-Lite Recorder gives permanent proof of temperature behavior. • 6" clear reading chart; various standard ranges from minus 40°F. to plus 550°F. • 3 standard types; choice of 24-hr. or 7-day cycle. • Electric or mechanical chart drive. • With capillary tubing for remote reading. Priced from $49.50.
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Model "1000"

THE ELECTRIC AUTO-LITE COMPANY
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TEMPERATURE RECORDERS

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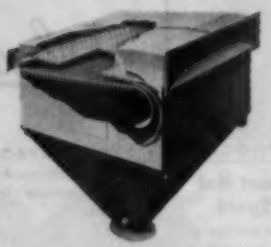
Buell-designed 'LR' Collector Stops Fly Ash From Small Boilers!



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BUELL MECHANICAL CYCLONE SYSTEM

High efficiency from 100 to 2000 BHP. Traps 99% of all 100-mesh and larger cinder discharge. Is effective on natural draft boilers!

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buell

Engineered Efficiency in FLY ASH COLLECTION

Circle 530 on Reply Card for more data

new bulletins

—*Starts on page 38*

starters using the EC&M 50,000 kva interrupting capacity type ZHS contactor are shown in indoor and outdoor installations. The Electric Controller & Mfg. Co.

231—Mass Production Transformers

Power Transformers being built at the new mass production Rome, Ga. plant are described in 40-page booklet GEA-6108. It cites applications and features of standardized single phase and three phase units, ranging from 501 to 10,000 kva, and lists complete dimensions, ratings, and specifications. General Electric Co.

232—Rotary Compressors

Operation and construction of single-stage water-cooled rotary compressors and vacuum pumps, applicable to every air or gas handling requirement, are described in 12-page bulletin 16B8126. It gives general specifications along with typical air piping arrangement diagrams and proper accessories designed to give the most satisfactory results. Allis-Chalmers Mfg. Co.

233—Engines

Engineering bulletin J-73 provides specifications and descriptions of the complete line of 13 in. bore and 16 stroke diesel, gas-diesel, and spark-ignited gas engines. Performance charts of atmospheric and super-charged engines are included. Cooper-Bessemer Corp.

234—Boiler Blowdown

"Boiler Blowdown Control," technical paper No. 128, is a reprint from **Industry and Power**, March 1954. Principal types of boiler blowdown are discussed, as well as various control methods necessary to assure production of pure steam and for keeping heat transfer surfaces free of scale and other objectionable deposits. W. H. & L. D. Betz.

235—Temperature and Pressure Control

Through years of experience in instrument design and manufacture, this company has developed a specialized line of equipment for the recording and indicating of temperature and pressure to fill your specific requirements. Seven-page bulletin G-158-A shows typical examples of such equipment with lists of specifications. The Electric Auto-Lite Co., Instrument and Gauge Div.

236—Dry-Type Transformers

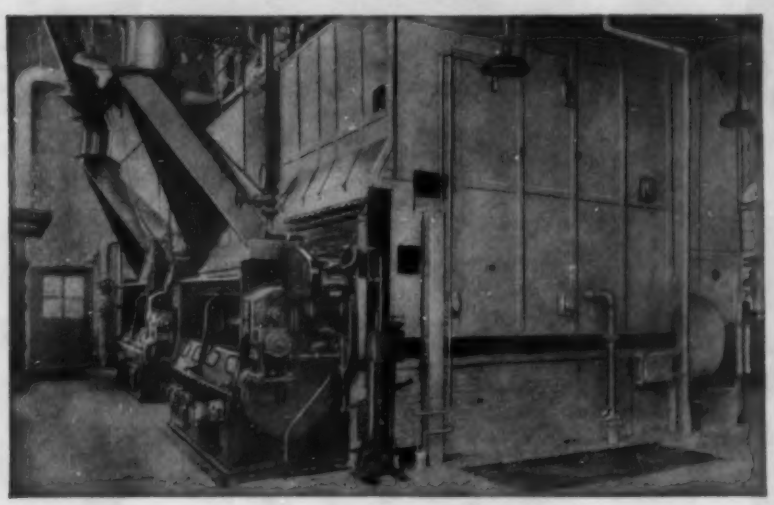
"Latest Developments in Dry-Type Transformers," seven-page catalog 153-A, presents the advantages of air-cooled units designed and constructed primarily for inside installations. Various types are pictured with specifications. Sorgel Electric Co.

(Continued on page 84)

"COAL'S BEST FOR OUR MODERN PLANT!

It's low in cost . . . It's clean and convenient!"

says G. W. Peters, Engineering Manager
M&R DIETETIC LABORATORIES, INC.
makers of PREAM & SIMILAC



"We made a careful study of fuels and burning equipment before building our modern new plant in Sturgis, Michigan. This plant was designed to produce baby food. So the steam plant has to be clean and dust-free as well as economical to operate. Also, we wanted a fuel we could store safely and easily in order to insure ourselves against any shortages.

"We decided on bituminous coal—and the up-to-date installation shown here. It certainly fills the bill on every count. Our modern combustion equipment makes coal far more economical than any other fuel. Up-to-date coal and ash handling give us convenient operation completely free of dust nuisance."

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Discover for yourself the great advantages of coal burned the modern way. Call in a consulting engineer. He'll show you how today's combustion equipment can give you 10% to 40% more power from a ton of bituminous coal than from equipment used only a few years ago. He'll show you how modern labor-saving coal and ash-handling equipment make a coal-fired installation clean, convenient, and dust-free.

If you plan to remodel or build a new plant, be sure to look into the low cost and convenience of bituminous coal. Consider coal's other advantages, too. It has reserves that are virtually inexhaustible. America's bituminous coal mining industry is the most efficient and productive in the world. With bituminous coal, you can be sure of plenty of fuel at relatively stable prices now and for years to come.

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BITUMINOUS COAL in most places is today's lowest-cost fuel, and coal reserves in America are adequate for *hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

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COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

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FOR HIGH EFFICIENCY *FOR LOW COST*

YOU CAN COUNT ON COAL!

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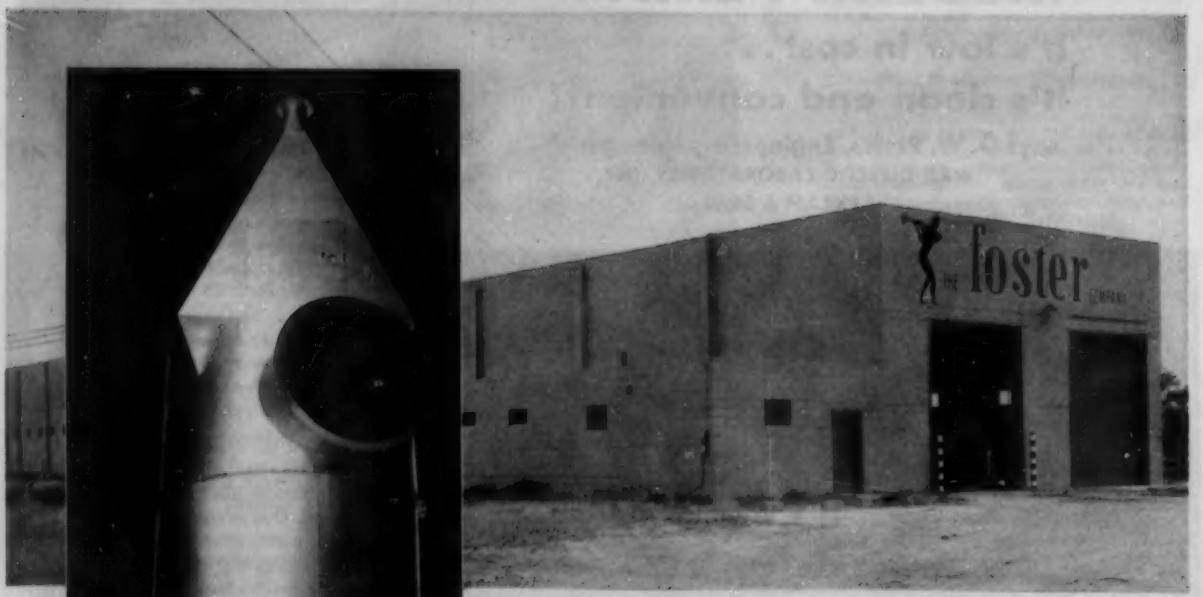
AFTER-COOLER FOR NEW DETROIT FOUNDRY



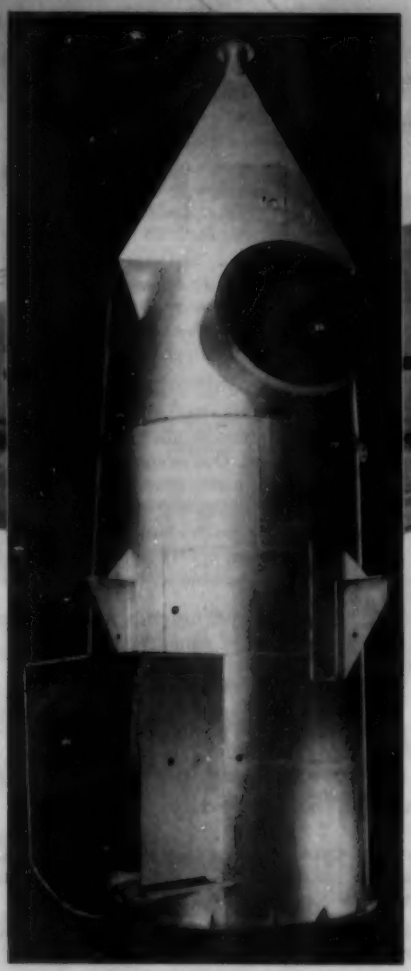


Photo at left shows one of two cooling chambers, integral components of vortex type dust collectors. Special design by Grindle Corporation eliminates dust, fumes, general smoke nuisance from expanded cupolas and stacks of major Detroit automobile manufacturer.

After-cooler pictured above is typical of heavy *precision* weldments manufactured by Foster. New building has heavy duty over head crane facilities; houses new equipment for shearing, burning, bending, braking, forming, annealing, sand-blasting.

Raw materials from nearby Gary-Chicago mills; deliveries by motor freight, railroads, barges via Illinois and St. Lawrence Waterways.

Tho costs are moderate, fine quality and agreed delivery are sole standard at Fosters.

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STANDARD HD
TRADE MARK
OIL

keeps rings FREE
(and cuts down wear!)

Bancroft Superintendent, Verne Austin (left) consults with Standard Oil lubrication specialist R. R. Spargo, (right) on periodic check-up to see that STANDARD HD is still in like-new condition.

Here's what Verne Austin, superintendent of the Municipal Light Plant, Bancroft, Iowa, writes about the effectiveness of STANDARD HD Oil: "Before switching to STANDARD HD Oil, we were troubled with ring-sticking, dirty crankcases, excessive port carbon, frequent cleaning and stack fires. Since switching to STANDARD HD Oil, ring sticking is at an absolute minimum, crankcases are *always* clean, port carbon is almost nil, stack fires are practically eliminated!"

Since this plant switched to STANDARD HD Oil, they have also had the help and advice of an experienced Standard Oil lubrication specialist. He has made regular, periodic calls to check the oil and to make sure it's still in like-new condition.

STANDARD HD Oil lubricates better because it cuts down wear . . . keeps vital parts clean. If you have any lubricating problems, call your nearby Standard Oil office. Or write to Standard Oil Company, 910 S. Michigan, Chicago.

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You turn on the steam.

This little stainless steel valve—the only moving part in the Yarway Impulse Steam Trap installed on the equipment—opens wide and *stays* open as the air and condensate continuously pour through.

The equipment reaches production temperature in the quickest possible time.

Production temperature reached, the little valve snaps shut. After that, by a pulsating action, it discharges all condensate as it forms—even a tiny teaspoonful. *There's hot steam in the equipment all the time . . .* steady, maximum temperatures are maintained.

It all adds up—to more production per day.

Other profit-making features of the Yarway Impulse Steam Trap—low initial cost, easy installation, stainless steel construction, low maintenance, good for all pressures, quick delivery from over 200 local industrial distributors.

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For free Yarway Impulse Steam Trap Bulletin T-1740, write . . .

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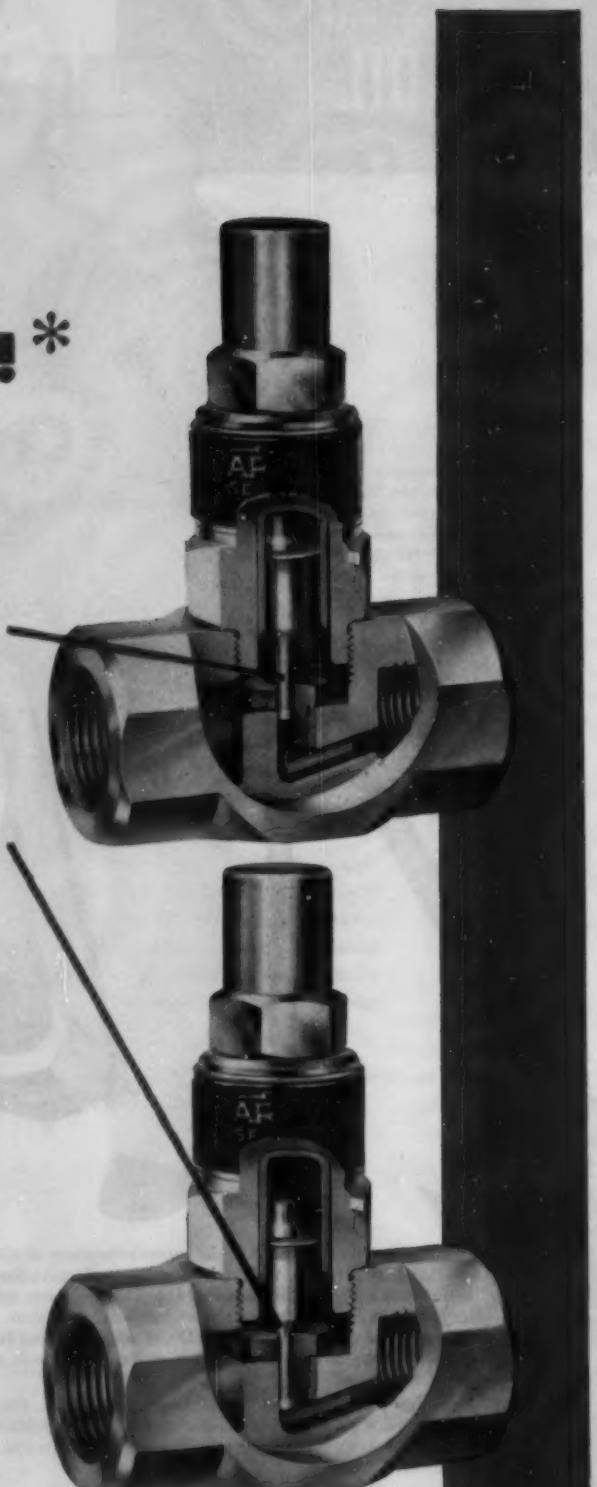

. . . resulting in fast heat-up of equipment, more production per day.

YARWAY | *impulse steam trap*

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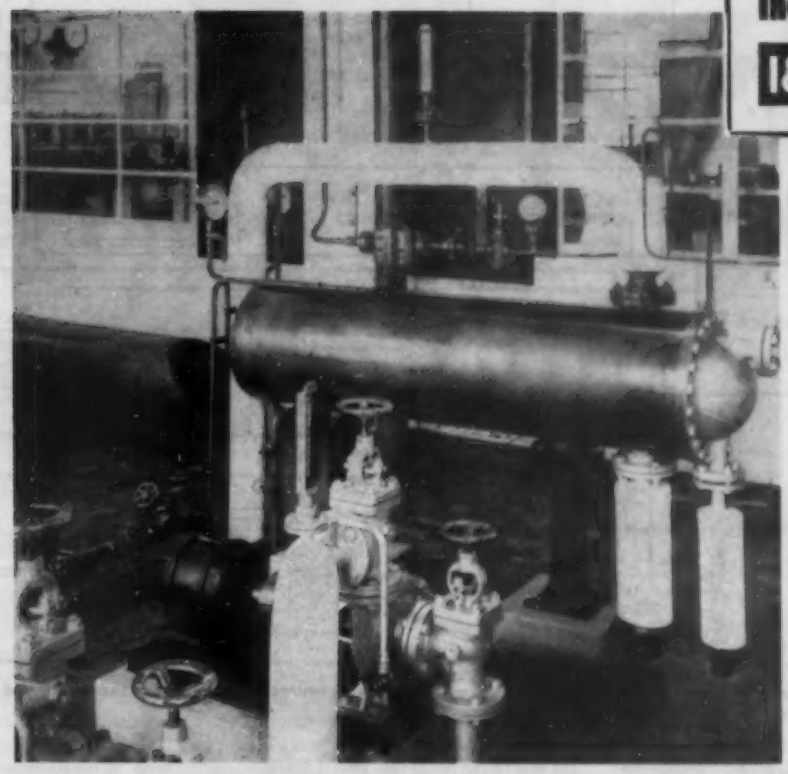


Exchanger converts high temperature water to warm water for office heating.

Why High Temperature Water?

OWEN S. LIEBERG, Mechanical Engineer

MANY ENGINEERS exhibit a steadily growing interest in high temperature water. Up until a few years ago high temperature water was almost unknown in this country, but in Europe it has been used as a medium for heat distribution for over 30 years. Today, the plant engineer, the man who is responsible more than anyone else for the efficient operation of a heat generating and distributing system, is becoming acutely conscious of economy, especially when applied to fuel consumption and maintenance. With costs continuously rising, economy will become even more significant.

Modernization and expansions present the plant engineer with opportunities to introduce ideas which not only reduce operating and maintenance costs, but also often increase production and improve product quality. These are factors of vital importance to executives and plant engineers alike. Progressive companies are converting their existing steam plants into high temperature water because maintaining uniform heat control is greatly simplified, and the savings effected can contribute materially toward the cost of conversion.

Design Temperature

What is high temperature water? It is water that has been heated under pressure to a temperature above 212 F — the normal boiling point at atmospheric pressure. In a closed circuit, this temperature can be 400 F and over. For economical reasons, however, 400 F (equivalent to a saturated steam pressure of approximately 235 psig) is a maximum for average requirements. Since most industrial plants usually are designed for not more than 150 to 160 psig pressure, the average high temperature water system operates at about 370 F. This is well within the economical range of the equipment used.

The simplest form of high temperature water generation is shown in Fig. 1. The expansion tank with its steam cushion above the water level not only serves to take expansion of the water system, but also provides a means of controlling and

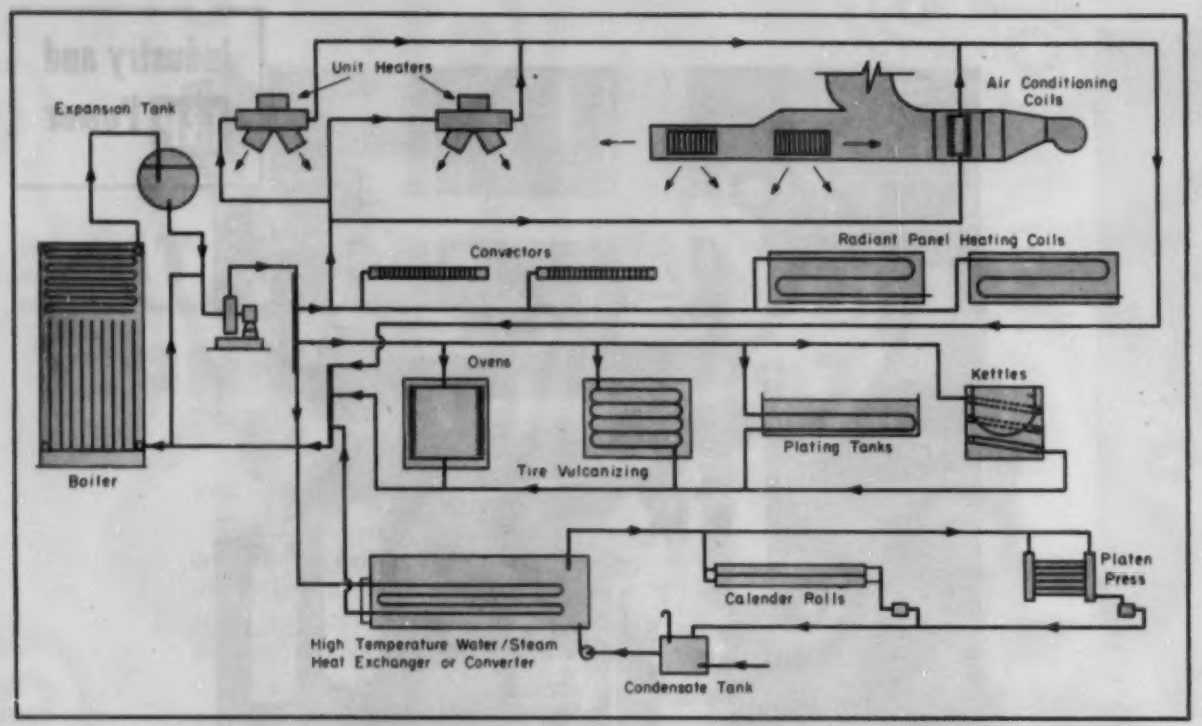


Fig. 1—Diagrammatic arrangement of typical applications for high temperature water in industrial and commercial plants.

maintaining the desired pressure. High temperature water is taken from below the water level, pumped under pressure to the farthest point of the system, and then returned to the boiler. Therefore, the heat produced is either completely utilized in the system or recycled to the generating unit.

Makeup

Since makeup requirements are only a few gallons a day (one plant with boilers totaling over 100,000,000 Btu per hour — equivalent to approximately 100,000 lb of steam per hour — takes only 20 to 25 gallons a day), any costly feedwater treatment is eliminated, boiler tubes are always clean, and high heat transfer rates are sustained. This is important because makeup water is a direct function of heat loss. If a steam boiler requires 15 percent makeup, a 15 percent loss of heat will be reflected in the fuel bills. Furthermore, the maximum output of the heating surface of the boiler or high temperature water generating unit is permanently maintained because no scale can form within the boiler tubes or heating surfaces. For example, recently the piping in the boiler house of one high temperature water system was examined after 10 years service when a new extension was connected into the supply line. The piping was as clean as the day it was installed.

System Components

High temperature water systems require the following equipment:

¶ Boiler or hot water generator.
¶ Expansion tank.
¶ Circulating pump or pumps.
¶ Controls.
¶ Piping and valves.

While these items are all necessary for any high temperature water system, if the conversion of an existing steam system is contemplated, frequently the existing boilers can be retained and possibly adapted to eliminate the expansion tank. Then only the pumps, controls, piping, and valves have to be added to the system. Of course, the type of boiler available will decide what changes are necessary. Although the water tube boiler is more efficient and has other circulatory advantages, if the supply high temperature water can be piped from below the water line and the water level maintained without serious fluctuations or undue turbulence, any boiler designed for the desired pressure can be converted.

When converting an existing steam system, the main costs are the dismantling of steam and condensate piping and the substitution of new piping for the hot water system. Condensate piping that has been in constant service for a number of years is subject to corrosion. While outwardly it may appear to be in excellent condition, its use for high temperature water at 150 to 200 psig pressure would not be permitted under any circumstances. However, the savings which will be effected over the following years are so high that the cost of replacing old piping is not a serious item. One company has been progressively extending their high temperature water system into other parts of the factory using steam, and paying for such extensions out of operating and maintenance savings.

Eliminating steam traps, always a source of expense and maintenance troubles, also increases the over-all efficiency of the system. The heat loss at each steam trap is far greater than most plant engineers realize, and removing all steam traps provides substantial savings. In addition, because the system is always under circulating pressure from the pumps, no pipe grading is required and the new high temperature water piping can be carried over machinery, in the roof trusses, under equipment, and otherwise dip or rise as circumstances dictate. Pipe thicknesses are identical with steam lines of equal size, but it should be noted that in the high temperature

TABLE 1 — TYPICAL APPLICATIONS OF HIGH TEMPERATURE WATER SYSTEMS.

Space Heating	
Unit heaters Air conditioning reheat coils Convectors, finned tubes Radiant heating coils	Direct heating by high temperature water at design conditions of the distribution system.
Process Heating	
Vulcanizing equipment Ovens with heating coils Tanks with indirect coils Kettles, jacketed or with coils	Direct heating by high temperature water at design conditions of the distribution system.
Calender rolls Heating platens	Direct heating by high temperature water at design conditions of the distribution system, or indirect heating through exchanger, high temperature water to high pressure steam.
Miscellaneous Equipment	
Domestic hot water heaters Radiators, existing cast iron Hot tables Radiant heating panels Snow melting coils	Indirect heating through exchanger, high temperature water to low pressure hot water.
Cafeteria & kitchen apparatus	Indirect heating through exchanger, high temperature water to low pressure steam.

water system all piping outside the boiler house must be welded. Flanges are only allowed near the boilers and pumps. Insulation requirements to prevent heat losses in the distribution system are exactly the same for any given size steam or hot water pipe.

Advantages

Briefly, the advantages of high temperature water systems include:

¶ No steam traps.
¶ No pipe grading.
¶ No elaborate feedwater treatment.
¶ Small diameter piping.
¶ No pressure reducing valves.
¶ Constant temperature control, regulation simple and flexible.
¶ High fuel economy.
¶ Uniform distribution of heat, independent of boiler pressure.
¶ No pipeline corrosion.

For many processes, the availability of heat at a uniform temperature is all important. The high temperature water system, because of the greater heat capacity of the hot water lines, assures what is in effect a "thermal flywheel". With the steam system, often boilers must be operated constantly at full load, especially in old plants where additional equipment has been added over the years. In such boiler plants sudden demands on the line can bring down the steam pressure, and as all engineers know, once down it takes skillful boiler handling to restore full pressure. With high temperature water systems, the heat content of the pipe is so high (ranging from 40 to 100 times that of steam according to the operating pressure or temperature), even high and sudden demands have no appreciable effect on any of the individual heat consuming units.

Temperature Differential

Normally, high temperature water systems are designed for a 100 to 150 F differential instead of the 20 F drop commonly used in low pressure hot water space heating. This enables the designing engineer to greatly reduce the diameter of the supply and return lines (being a closed circuit, both are the same diameter), thus reducing the initial cost of piping, valves, and fittings. In a large system the savings can amount to several thousand dollars.

Reference to the typical system diagram, Fig. 1, shows that the heat consuming units vary considerably in type, pressure, and demand. In some instances the units can be heated directly with high tempera-

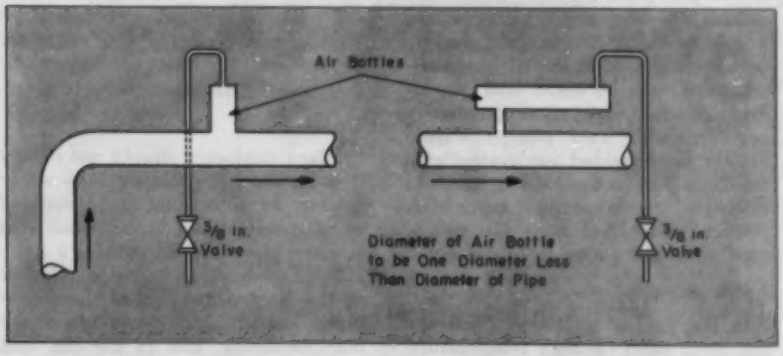


Fig. 2—Air bottles and air piping for venting high temperature water systems.

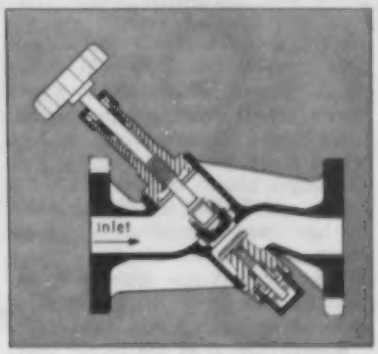


Fig. 3—High temperature water valve.

ture water. Others will require heat exchangers for converting water to steam or water to water, although the high temperature water is always the primary circuit. The use of a heat exchanger, with its small but important reservoir of heat, serves to prevent sudden fluctuations. Temperatures at the various heat consuming units can be individually controlled within close limits, thereby giving wide flexibility of application.

If a heat consuming unit requires steam, for example sterilizers and certain types of calenders using rolls, the steam pressure can be set independently of other adjacent equipment; or it can be quickly changed if the process so demands. It is not unusual to see a number of small heat exchangers, all operating from the same high temperature water supply line, efficiently providing steam at pressures of 10 to 125 psig for various processes and hot water for others. Typical applications are shown in Table 1.

Accumulators

Many steam generating plants have a high peak steam load for a few hours but a low demand for the rest of the day. Others operate steam turbines fully loaded for 8 hours and only lightly loaded the balance of the time. Such fluctuations are uneconomical, especially with coal fired boilers. For both conditions, steam can be converted into high (or medium high) temperature water at 250 to 350 F during off-peak hours, stored in an accumulator, and then used during peak load periods. Such high temperature water storage is very effective and efficient, greatly reducing the over-all cost per pound of steam. Often the heat in steam which is wasted during the day can be used later during night shifts for space heating.

Accumulators also are helpful in instances where the extension of plant and equipment might overload the existing boilers. At one factory, a new building was planned half a mile from the old boiler house. Instead of putting in a new boiler, steam generated during off-peak hours was converted to high temperature water through a heat exchanger placed outside the boiler house, and the hot water was stored for later use. This arrangement not only permitted use of the existing equipment, but the increased annual load factor of the boiler plant reduced the unit steam cost.

Redistribution of the boiler loading can be very important. For example, assume a new building, 500-ft long x 100-ft wide x 20-ft high, requires a maximum of 6,000,000 Btu per hr for space heating during 10 full load hours, or a maximum daily heat demand of $6 \times 10^6 \times 10 = 60 \times 10^6$ Btu. With an accumulator, this demand can be spread over a 24-hr period, thereby reducing the hourly boiler load to $(60 \times 10^6) / 24 = 2.5 \times 10^6$ Btu.

Valves and Fittings

Since air will collect at all high points in the system both on the initial fill and at intervals during operation, it is essential that air vents be fitted at such high points. Fig. 2 shows two designs of air bottles with air piping carried down to a lower level for accessibility. Air bottles should be manually operated.

Control valves and shutoff valves also must be carefully selected. Fig. 3 illustrates a valve recently developed especially for high temperature water. This valve with its mushroom seat and 45 degree angle gives an almost straight through passage. In addition, the lower stem provides a regulating or balancing control which, when once set, is never changed except by the authorized operator. Valves for high temperature water should have cast steel bodies and stainless steel trim.

Pumps

With all high temperature water installations, circulating pumps are placed in the supply line to keep the system under pressure and above the flash point. A bypass line between the supply and return lines allows a small quantity of the return water to mix with the supply water and prevent flashing at the pump suction. This bypass line is manually controlled. Pumps for high temperature water should have water cooled bearings, stuffing boxes, and gland flanges; cast steel casings; and suction inlets that are shaped to reduce cavitation.

The pump head must be carefully calculated, and since temperatures are 300 F and above, the density and specific heat at the highest temperature must be taken into consideration when determining capacity requirements. Two pumps should always be provided for system circulation. Where the load is liable to fluctuate, it is sometimes more economical to use 3 or more pumps according to the variation of demand.

Applications

In the rubber industry, vulcanizing units utilizing high temperature water are speedier in operation than steam units because of the more even heat transfer. With platen presses, high temperature water, by giving a constant temperature over the entire surface of the platen or mold, improves the product and increases production.

Using liquid carriers for the heating and cooling of equipment previously heated by other methods also is attracting the attention of machinery designers in the plastics industry. Equipment, which although once adequate for production, must now meet new conditions created by new processes requiring better quality, higher temperatures, and greater uniformity. Heat transfer controls are critical, and uniform temperature over the entire surface of a roller, for example, is imperative.

Uniform Heating

Where surfaces are alternately heated by steam and cooled by water, the product always will be affected by inadequate removal of condensate, thermal shocks due to the change of medium, and uneven surface temperatures. Here again the accumulator is effective. Frequently, the use of a high temperature liquid can double or even treble the number of production units served per boiler.

Exhaust Steam Conversion

Factories generating their own electric power can bleed steam at a suitable pressure (for example, 50 psig — corresponding to 297 F) and transfer the heat through a heat exchanger into high temperature water. This eliminates the transmission heat losses and distribution distance limits that are typical of systems taking low pressure steam directly from the turbine. With high temperature water, the distance of transmission is merely a matter of circulating pumps and pipe design. The water in the return circuit also can be used to preheat the feedwater. Over-all efficiency of a turbine generating unit, therefore, is directly affected by the economic factors of the heat conserved by such a heat distribution system.

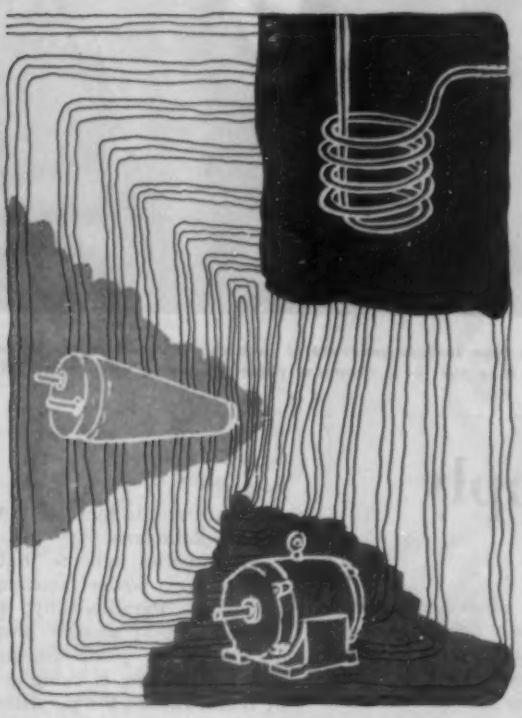
Conclusion

Plant engineers should not lightly dismiss the high temperature water system as something unproven, or as an arrangement for someone else to use. They should carefully consider its economic value in relation to the heat utilization of their own plant, to the product they are manufacturing, and to the life and maintenance of their equipment.

In-Plant Electrical Distribution

. . . New Trends Take Shape

I&P STAFF REPORT



This is a staff report presenting the very latest trends in the distribution of electrical power in industrial plants — from the point where power becomes available to the points of utilization. To prepare this report the editors visited and talked with those people who know best what modern plants are like—and who will be shaping the patterns for tomorrow's in-plant electrical systems.

We talked to the manufacturers who are responding to industry's demands for the latest in equipment. We talked to the consulting engineers who design the facilities that industry wants for its new plants. We talked, too, with those plant engineers who are running some of the very newest plants, and who are living with the most modern electrical distribution systems. And a group of INDUSTRY AND POWER's readers were sampled to find out the current nature of their interest in this subject.

From the talks and tours that preceded this report, we digested and distilled. On the pages that follow is the essence of the trends we found—reduced to words and pictures. This summary of effective trends should be of real value to all engineers concerned with providing industrial plants with electric power service—from the service entrance (or in-plant generator) to the utilization devices.

To order additional copies of this report, use coupon on page 117

Electro Metallurgical Company

In this industrial power plant there are four extraction-type turbine-generators; each unit is rated at 40,000 kw. One of the largest industrial power plants of its type, it is part of a chemical plant producing alloy materials.

Demand and Supply

THE IMPORTANCE of electrical distribution to the industrial plant is increasing every year. In 1939 the use of electricity in manufacturing industries averaged 4.9 kwh per manhour of production; today, this figure is 9.5 kwh per manhour; by 1963 it is expected to rise to some 15 kwh per manhour.*

In gross terms, the increased utilization of electricity by industrial plants is even more staggering: in 1939, industry used some 79 billion kwh; in 1953, industrial consumption was 257 billion kwh; and by 1963 it will be 400 billion kwh per year.*

To a degree, this load growth results from increases in the amount of plant area being served. But the greatest portion of it stems from the increasing electrification of processes and manufacturing operations, which boosts load densities in already existing plant areas. Also, the experience of the past few years reported by a leading designer and builder shows that all office areas in new plants and fully 50 percent of the new plants themselves are air conditioned.

*Westinghouse Electric Corporation

Why Demand Increases

Many explanations for the load growth in industry are given. But the underlying factor is that industry is struggling against rising labor and material costs; it is turning to electricity as its best buy to lower unit costs, to increase output per manhour, and to increase output per unit of plant area.

All statistics indicate that industrial electric power consumption is going up. Paradoxically, statistics also show that smaller proportions of the power being consumed by industrial plants is being generated by them; rather, the persisting trend is toward purchased power. In 1939, industrial plants generated 41.5 percent of the electric energy they used; by 1952, this figure had dropped to 28.8 percent.

To the plant engineer who must get electricity into and around his plant, the trend is important; why are more of his brethren around the country buying their power instead of generating it? The answer is that utilities can give economical power with good reliability in most localities. There are exceptions, to be sure. But the utilities generally

can give power at rates cheaper than in-plant generation — and with satisfactory reliability.

In-Plant Generation

A given firm can justify in-plant generation if it has substantial need for process steam or if a byproduct fuel is available. It then can get electricity as a cheap byproduct with only a little more boiler, some generating gear, and a bit more fuel. Even then, it takes almost 24-hour-a-day operation throughout the year to bring utilization factors on the power plant investment within limits which make the cost of in-plant-generated power appear attractive.

The trend toward purchased power is even going to the point, in some areas, where utilities not only supply electricity, but they also supply the process steam which formerly might have been justification for in-plant generation. This is occurring across the country, from New Jersey to California and points in between.

Part of the problem, too, lies in the fact that the use of electricity in industrial plants is increasing faster than the use of process steam. A corollary problem is that of peaking the steam load in step with the electric load.

Many plants require tie lines to utilities, anyway, for that portion of their electrical load that they themselves can't generate economically in conjunction with process steam generation. Tie lines for emergencies or peak loads are costly and, if installed, they would cost little more if designed to bring in all the plant's electrical power.

Costly Generation

One steel mill with waste gases available as free fuel has found that in-plant generation was still costing more than purchased power would. The mill now uses its in-plant generation equipment for standby service only. There is opinion in the steel industry, expressed from the very highest echelons, that more power will be purchased than generated by the steel industry in the future. In recent evaluations by consulting engineers, some plants have found that they could buy power for 10 to 30 percent less than it was costing to generate with their own in-plant equipment.

Though power generation equipment warrants a write-off period of about 25 years, industry has become accustomed to expecting a 100-percent return on production equipment within five years. Generally not disposed to consider that power generation equipment is of a different stripe, industry finds itself not wanting to grant any longer amortization periods for generation equipment than it allows for production equipment. The resulting costs per kwh assigned to in-plant generation shoot higher than is tolerable in competition with utility rates. The utilities use the longer amortization periods in computing rates (and their net return is limited to about six percent).

Product Cost Structure

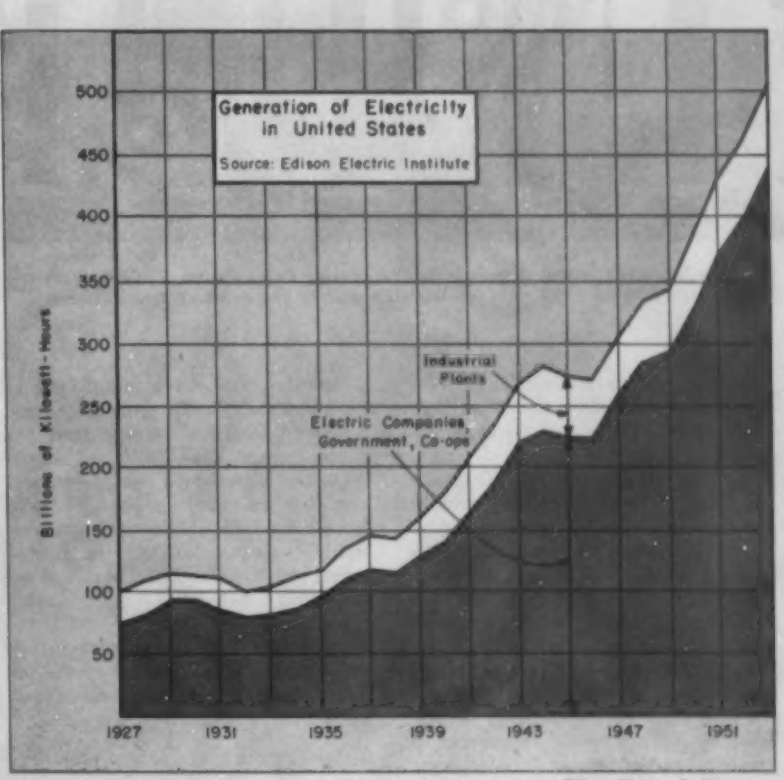
Say that electricity represents but two percent of a product's total cost; savings of even 25 percent by in-plant generation would only mean a ½-percent saving in product cost. Management would rather invest its money where a better cost advantage could be realized. One rule of thumb considers that if electricity accounts for anything less than 15 percent of a product's cost, more fertile fields for product cost reduction exist elsewhere. (For a typical metal-working plant, power costs represent only one to four percent of the manufactured product's total cost.)

Management just does not want to be tied up in the power business any more; it wants to devote all its attention to the primary profit-making endeavors to which it is basically committed.

Accounting Problems

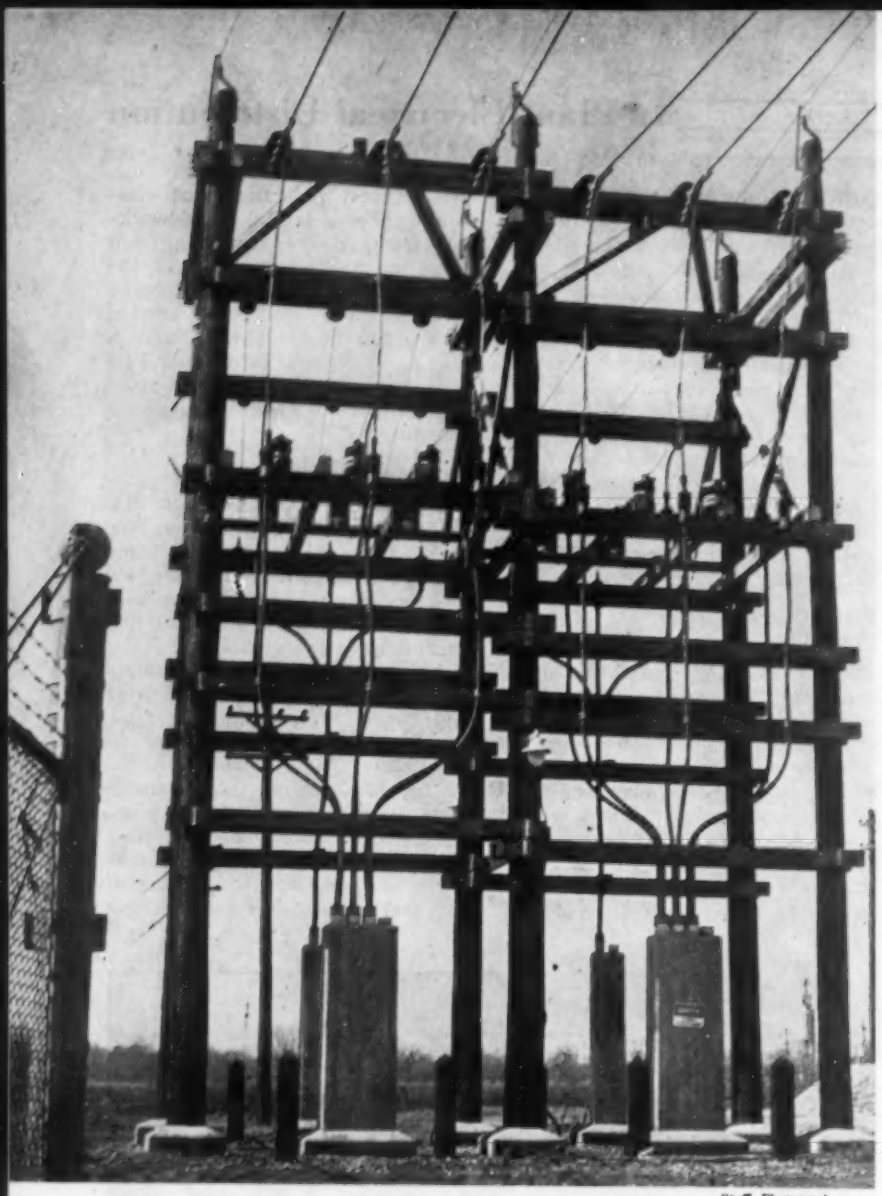
The changing tax situation also plays a part in determining how dear a firm's funds are at the time generation equipment is to be paid for; this may make in-plant generation look like a good deal or not, depending on the situation.

Accounting methods themselves can differ enough so that intellectually honest appraisals of the same situation can give rise to opposite conclusions. The incremental method, for one, assumes that steam at certain conditions is needed for process anyway; the cost of generating electricity is then only an increment over and above the equipment and fuel cost needed for the base



Edison Electric Institute

Though total generation has persistently risen over the years, in-plant industrial generation has contributed comparatively little to the rise.



Staff Photograph

These are the incoming lines from TVA serving Pennsylvania Salt's Calvert City, Ky., plant; the lines go underground to the primary transformers.

load in process steam. The other point of view takes the total cost of the power plant and assigns costs to process steam and to electrical generation according to the Btu's used by each; this method usually gives a higher cost for in-plant generation of electricity though such sharing of all plant costs does reduce the unit cost of the process steam. The incremental method, however, is most widely used.

Another significant point is in the matter of reliability. An extra unit for standby duty in an industrial plant usually represents a greater percentage of additional capital investment than does an equal amount of reserve capacity in a utility system. For example, a 5000-kw unit may supply all of an industrial plant's load; to provide a second 5000-kw reserve unit (or some compromise such as three 2500-kw units—two for duty and one for reserve) probably could not be justified on economic grounds though service continuity might demand it. Currently, greater load diversity, extensive interconnections, dual feeds to plants, and automatic throwovers are making utility reliability more than adequate for many more industrial customers throughout the country.

Diesel Generation

Proponents of diesel generation make a case for in-plant generation pointing out that waste engine heat from a diesel-generator set can be recovered as a byproduct for heating, thus bringing down the cost of generated power. A 9000-kw unit is quoted as generating at 8.61 mills per kwh with no heat recovery; the cost of power goes down to 4 mills per kwh with heat recovery from the engine's cooling water, oil, and exhaust.

Admittedly, there are several factors which affect the economic feasibility of diesel generation (or steam-plant generation), and these factors themselves vary from one place to another: fuels availability, local agreements as to the number of men on each shift and their wages, the demand and diversity factors of the load, and the duty cycle of the load.

Standby Power

Many continuous processes would be fouled up for hours, days, or even weeks upon an electrical outage of mere minutes or seconds. Oven fans, pumps, conveyor motors, and similar devices often demand essentially continuous power to prevent burnouts and jam-ups. Since such situations are becoming more prevalent throughout industry, instantly available standby power is becoming of great concern to plant engineers. Though costly, automatic throwover to standby power is becoming more important.

Where instantaneous availability of power is required, throwover to standby battery may be provided; however, the limited ampere-hour life of batteries makes them less desirable for applications where long outages (exceeding a few hours) are expected. Inversion equipment, to supply ac, is often required and adds to the cost.

Break-Even Point

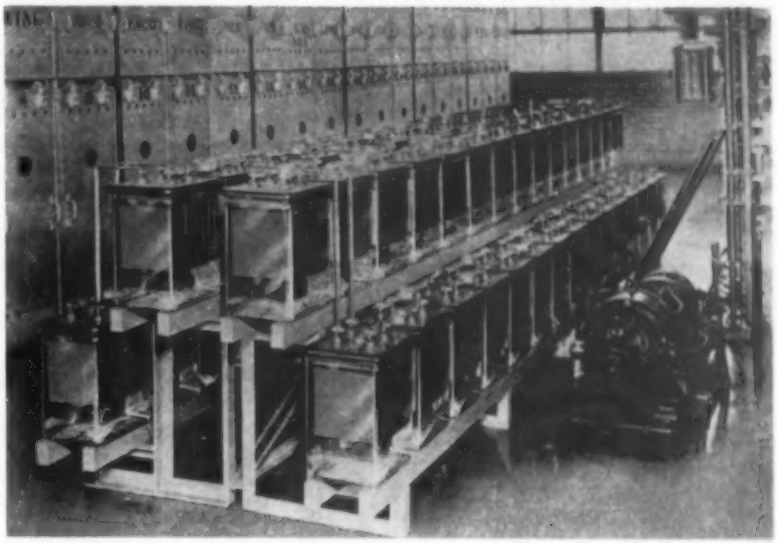
There is a break-even point where the cost of additional battery capacity (plus providing physical support, enclosures, and maintenance) becomes prohibitive in comparison with the cost of a diesel- or gasoline-engine-driven generator, fuel storage, exhaust and cooling facilities, and engine maintenance. There is considerable difference of opinion as to where this break-even point lies; it depends on many variables such as value of instantaneous throwover, frequency and duration of outages, and amount of load to be carried.

When an engine-driven stand-

by generator has been decided on, the gasoline unit is widely preferred over the diesel because of its lower initial cost. The diesel's chief advantage is in lower operating cost, but—as one manufacturer of both types advises—it would take some 1500-hours operation per year before the operating economies of the diesel would overcome its greater initial cost. (Some would take issue with the 1500-hour figure.)

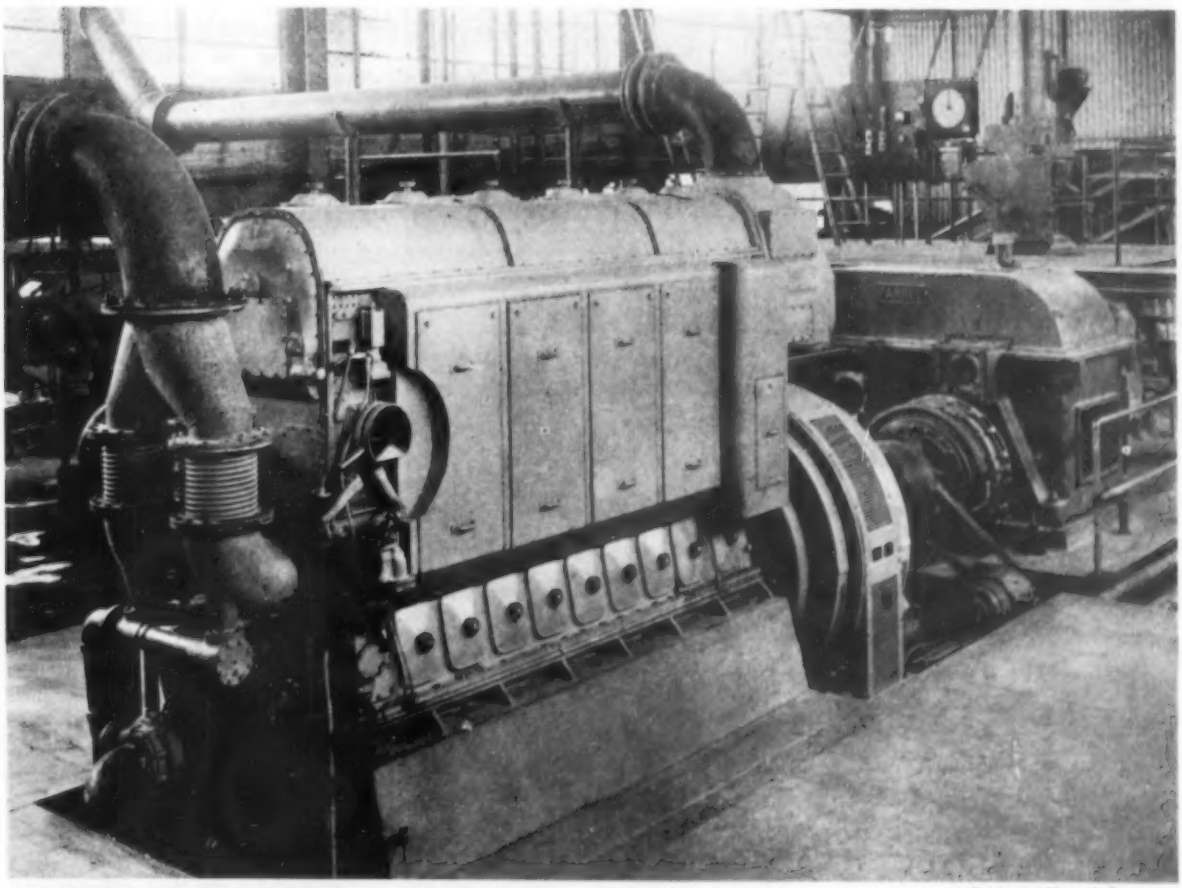
Study Feasibility

Certainly, the use of electrical power by industry is increasing by all measures—and this power is being obtained more frequently from utilities than from in-plant equipment. But where there are large demands for process steam or where byproduct fuel exists, specific studies on the feasibility of in-plant generation for particular cases are still widely recommended.



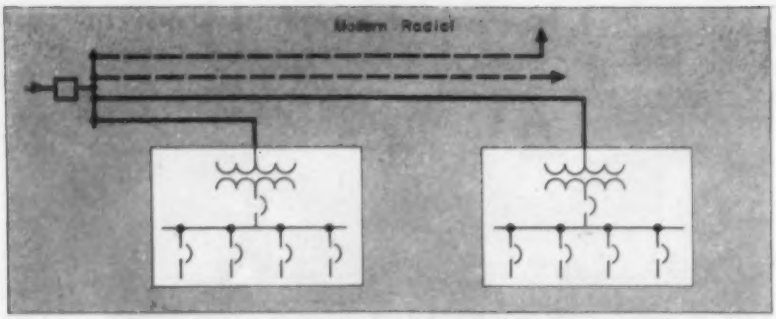
Electric Storage Battery Company

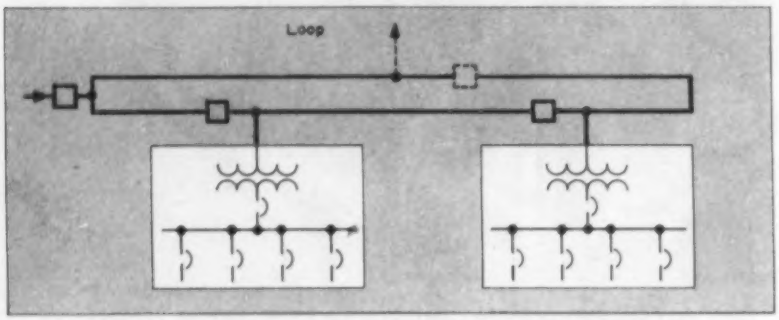
This sixty-cell storage battery installation provides standby power during emergency situations; it supplies power for lighting and certain pumps.

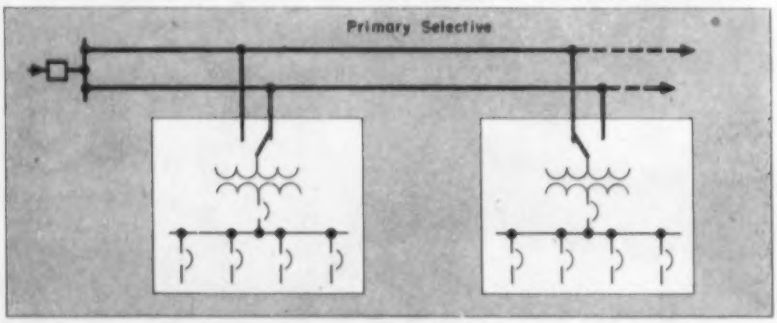


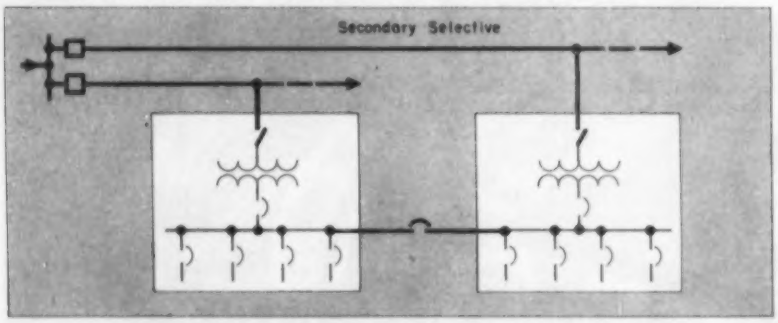
Fairbanks, Morse & Co.

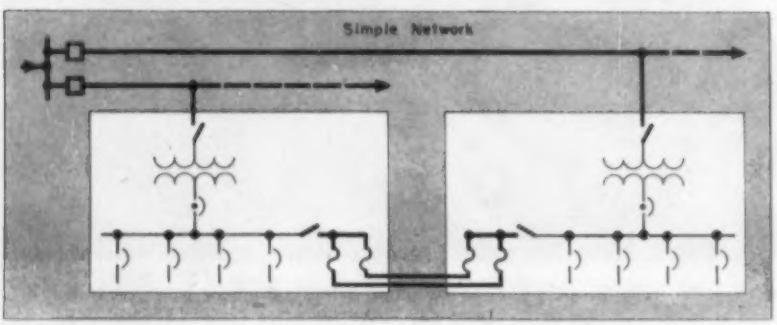
This diesel-generator, installed quite recently, supplies a-c power to the plant, drives a Banbury mixer, and also turns over a small d-c generator. The unit is rated 1280 hp; its 24-hour-a-day operation often extends several days.











System Circuits

About 99 percent of the modern, industrial electrical distribution systems are load center schemes. Of the many variations in primary circuitry, five are growing most significant to the exclusion of others: simple radial, looped primary, primary selective, secondary selective, and network.

Perhaps the most important factor in making a choice among circuits reduces to comparative costs, particularly in terms of what they will buy in service continuity. Taking the radial system as unity, the following relative costs are widely accepted for different systems serving the same industrial load:

Simple Radial	1.00
Looped Primary	1.10
Primary Selective	1.25
Secondary Selective	1.50
Network	1.75

Depending on such things as breaker application, the looped primary system can cost far more than the 1.10 indicated above; some engineers feel this system should be used only for serving large-current loads, and that it is rarely economical for the usual industrial plant. Also, the 1.50 figure for secondary selective systems is considered by some to be a maximum, with 1.10 to 1.15 the more common range for this type.

It is estimated that for 100 representative new plants, 5 to 10 of them use a network system, 15 to 20 use the secondary selective arrangement, and 50 to 65 use the simple radial; the rest will use the looped primary or primary selective systems.

The thinking which is mushrooming on the subject of primary circuitry rests on the thought that simplicity is reliability. Equipment reliability is singularly vital in encouraging the swing toward simplicity. When transformers, primary cable, and cable terminating methods were less reliable than they are today, simplicity was not

These circuit arrangements (left) account for the vast majority of primary systems being considered for modern industrial plants.

practical; service continuity could be insured in no other way than by providing duplication all along the line. But now, the failure rate for modern liquid-cooled transformers is about 1 per 2500 transformer-years; primary cable failures now average about 1 per mile per 100 service years; use of modern cables with improved terminating techniques has virtually eliminated failures in normal cable installations.

Since improved system components reliability is becoming more widely recognized, engineers feel safer in advocating simplicity — in placing all their amps on one circuit. Some engineers consider that modern systems can be said to have a reliability of 98 percent, even including simple radial systems. These are the foundations of the swing toward radials and their immediate derivatives. Radial and secondary selective systems are estimated by some to be used in 90 percent of all new installations.

When the ultimate in reliability is required, the network system is used. The principal applications for network systems come up in plants having loads of 1000 kva or more at load densities exceeding 10 v-a per square foot, where a minute's outage may cause hours and days of shut-down for cleanup, where engineers are available who understand the system and can keep it running, and where there exists a small private utility, in effect.

When the choice of a network system is under consideration, the secondary selective (with automatic throwover) is most often the competing alternative; some plant designers feel that the radial system is entirely too unreliable for critical continuous-process plants, and that the network system is too costly. The likely compromise (if permissible at all) is often the secondary selective — on the basis of economy with reduced hazard of prolonged outage. Some plant designers are quick to point out that the reliability of a network system may exceed the reliability of other equally critical plant services such as process steam or compressed air.

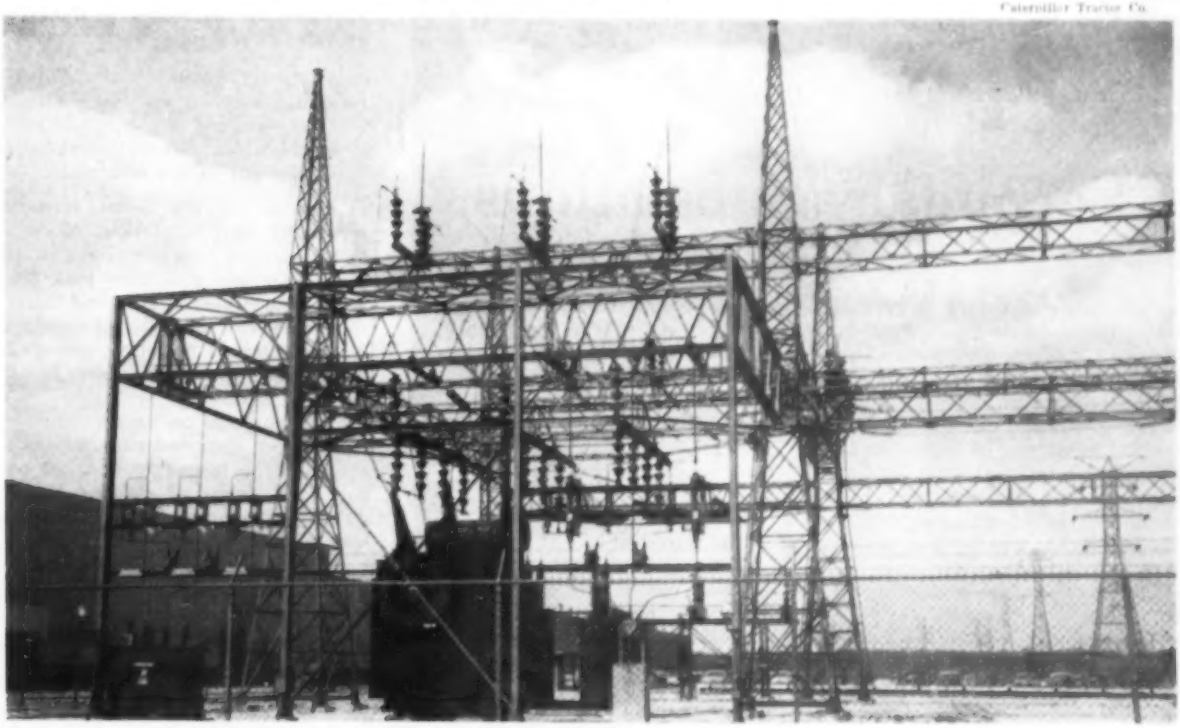
Very often, the network is used for specific spots within a plant. This underscores the growing degree of sophistication among engineers in selecting systems; plants are tending to use different circuit arrangements in different areas according to the nature of the load in each area. Instead of making a blanket decision for the whole plant, each major load area is coming in for individual attention as to the service continuity to be provided.

Primary Substations

The primary substation is widely understood as the one at the plant's service entrance, designed to step down the incoming subtransmission voltage to the plant primary voltage (or it is the substation at the in-plant generator feeding the plant primary system). The secondary

Utility supplies Caterpillar's plant with 132 kv over towers coming from the right; incoming power is stepped down to 12 kv for primaries feeding the plant (left). Note the ample room left for expansion of yard.

Caterpillar Tractor Co.



voltage of these stations is over 600 v, by definition. (Secondary substations are defined as those whose low side delivers utilization voltages — under 600 v.)

The distinguishing characteristics of the primary substation (aside from larger ratings of components) are in the class of equipment it may contain which is not usually found in secondary substations: breakers on the high-voltage side, tap-changing-under-load (load-ratio control) equipment, and surge protection equipment.

Where alternate incoming feeds to the primary substation are provided, high-side breakers may be used instead of switches and fuses; load-break switches, rather than disconnects, are widely preferred for this service, however.

Regulation

As far as over-all plant regulation is concerned, tap-changing-under-load gear is usually limited to the primary substation transformer — though most plants (particularly smaller ones) forego even this, being satisfied with the utility's regulation. But there is a trend toward more interest in regulation equipment at the primary substation.

The plant engineer is very often not directly concerned with these things because many utilities insist on owning the primary substation themselves, with access granted the customer only when utility personnel are present. Some utilities do have more flexible attitudes on ownership, and some may definitely ask that the customer supply the primary substation.

Plant Primary Voltages

The adoption of higher voltages continues. Sharper thinking is ruling out timid advances from one standard voltage to the next standard voltage. Bold steps, based on sound engineering thinking, are resulting in complete bypassing of certain levels in the swing to higher primary voltages.

Below the 15-kv level, there is definite preference for 4160 v and 13.8 kv. There is almost universal feeling that to go to anything less than 4160 v for loads up to 10,000 kva is to lose the full advantages of higher voltages — and the leap to 4160 v costs no more than settling for something less.

The interrupting duty (over 250,000 kva) imposed on switchgear at 4160 v gets to be rather expensive for systems over 10,000 kva; this is the principal influence for further up-voltaging. The next jump is a sizeable one — to 13.8 kv — since engineers similarly seem to feel that in going above 4160 v they may as well make a significant advance.

In really big, multi-building plants with high load densities there is a trend toward subtransmission voltages for the plant primary system feeding the building substations. The next jump might well be from the 15-kv class to 34.5 kv. The problem with voltages above 34.5 kv is that no metal-enclosed equipment is available and switchgear is expensive. But for plants of 500,000 square feet or less, the 15-kv class is usually adequate.

This thinking follows from the modern concept of plant design which freely admits that a plant built today may face distribution inadequacies in the near future. Inflexibly rugged industrial homesteads are no longer built with the complacent thought that immediately upon completion "this is it." Industry is becoming more expansion-conscious, recognizing that it must be aware of tomorrow's needs even while in the midst of completing present expansion.

Up Voltage Sooner

Such attitudes filter into electrical distribution system planning. That is why plants with present loads of 5000 or 8000 kva may be installed with a 13.8-kv primary system; previously, such a high voltage would not have been considered for anything less than 10,000 kva. But today's 5000-kva system may be expanded to 10,000 kva sooner than would have been admitted by the modes of thinking prevalent a few years ago.

Secondary Substations

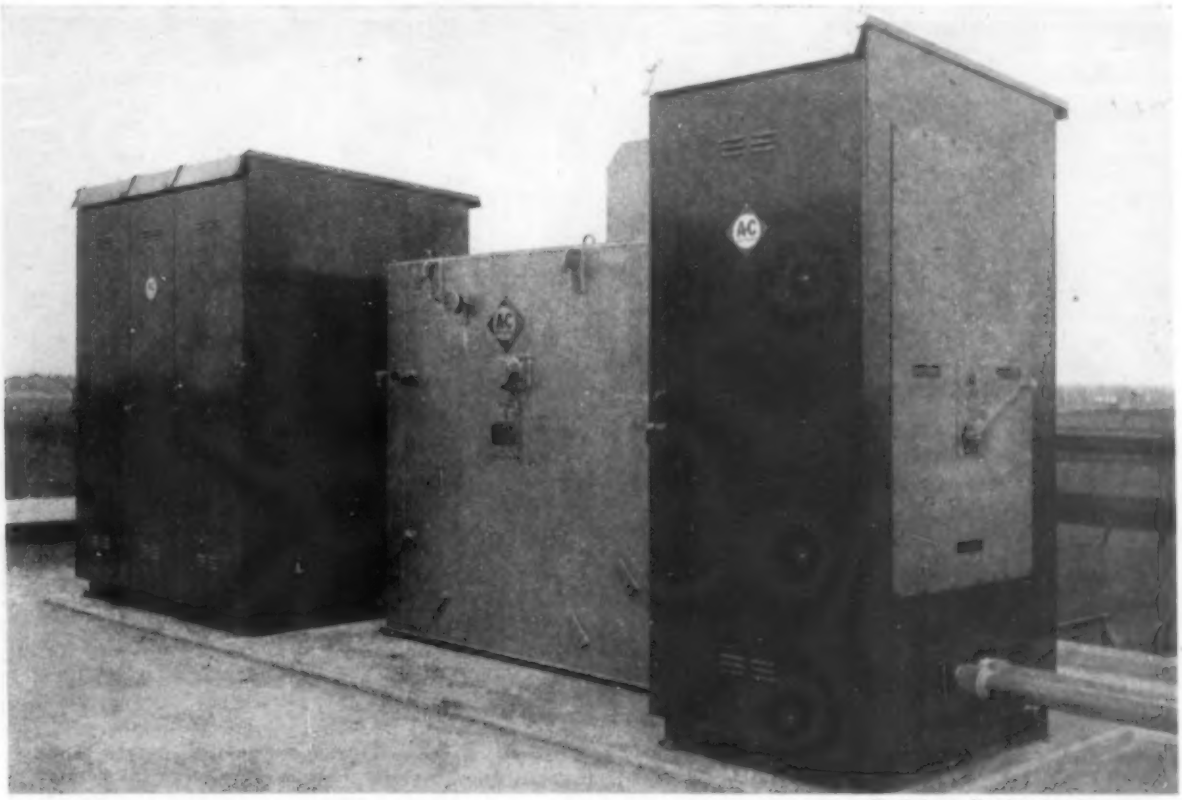
Packaged secondary substations have found such widespread acceptance that engineers now universally understand that they are being included in any discussion of plant electrical systems. No one thinks in terms of open switchboards with exposed knife blades or clips anymore. Now the problem is to determine what goes into the package and where the package should be placed.

The trend has been to spot more transformer substations (each of smaller capacity) around a plant in order to bring power at high primary voltages as close to the load as possible; voltage drop and conductor losses are thereby reduced. Also, the reduced interrupting duty resulting from smaller load blocks often brings the over-all costs of switchgear down. About 500 to 1000 kva per secondary substation is presently considered the optimum for secondary service at 480 v.

Larger Ratings

The introduction of high-interrupting-capacity fuses to provide back-up protection for breakers of moderate interrupting capacity promises to make 1500- and 2000-kva substations more prevalent in the future. This is especially desirable since the trend is for load densities to increase in the areas already served by each substation. Modern metal working tools are taking twice the power per tool they took ten years ago as deeper cuts and faster speeds become the order of the day. And equipment formerly powered with other energy is now being powered electrically.

Floor space is no longer considered a free item and so substations are going up among trusses, out on roof tops, down in basements, or outside at ground level. Basement and outdoor ground-level locations have an advantage over the overhead ones — no structural problems arise from the substation's added weight on trusses and beams. Though such structural problems can be accommodated in the design of a new building, they are particu-



Allis-Chalmers Manufacturing Company

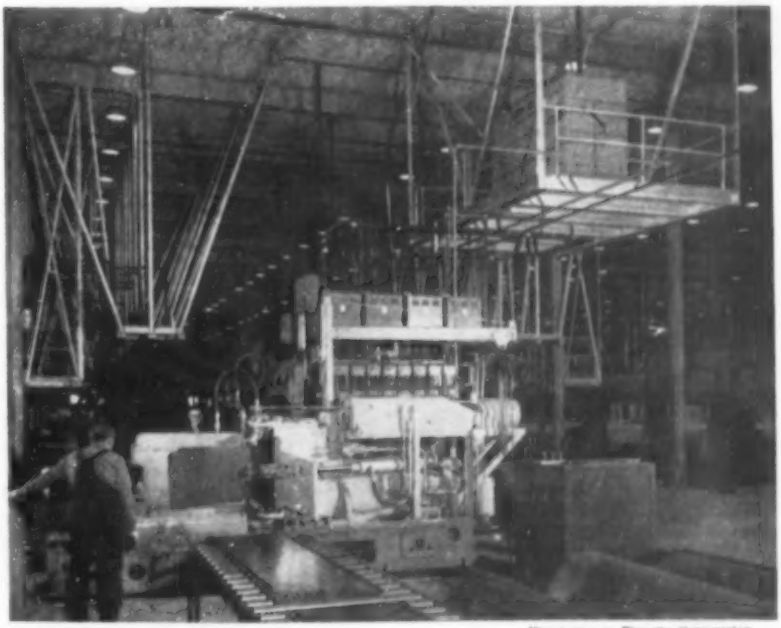
This outdoor substation is on the roof of a locomotive manufacturer's plant. It is rated 300 kva; the transformer is a dry type sealed in nitrogen. The primary side has a load-break switch and the secondary has 1200-a breaker.

larly knotty in an already erected structure.

Substations out of sight are (once in a while) substations out of mind, and there is a tendency toward negligence in the maintenance of substations in out-of-the-way locations. Roof-top installations have added disadvantages in that they sometimes cause roof leaks, and they can be difficult to install or move later.

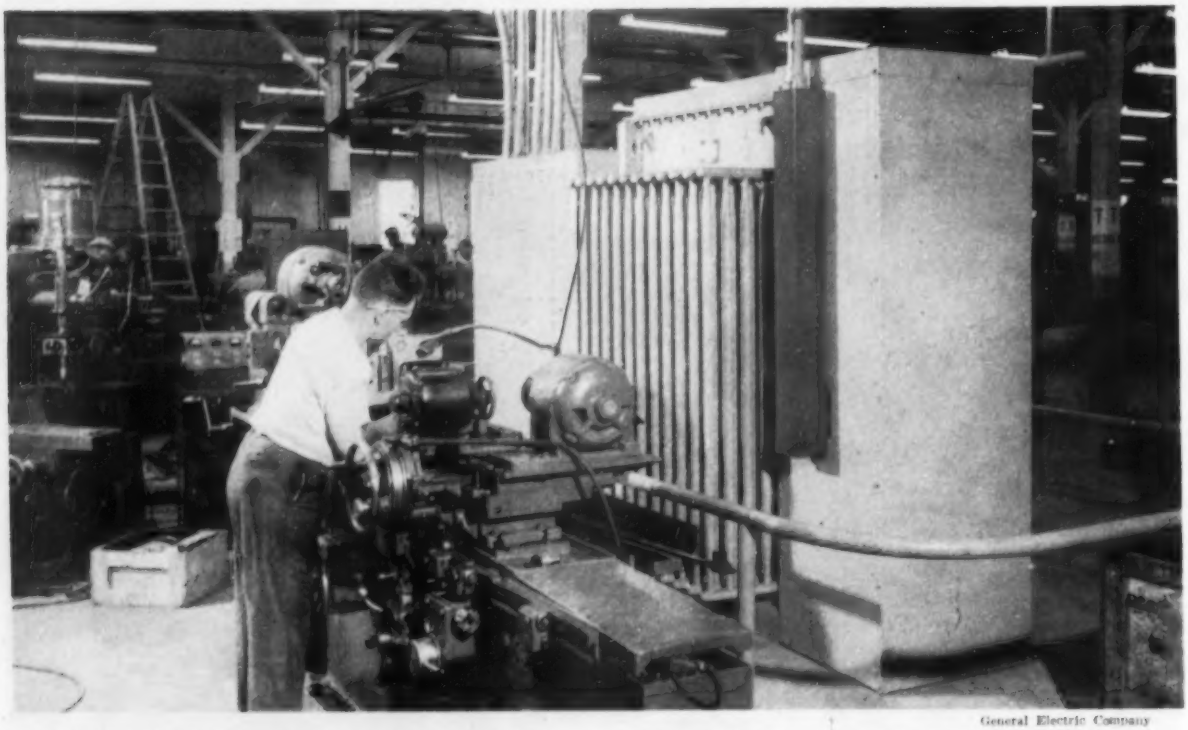
Outdoor Substations

All outdoor substations—at ground level or on roof tops—cost more because of the weatherproof housing and frequent painting which may be required; they also are hard to attend in bad weather. Most important, the ground-level outdoor substation may wind up so far away from the electrical center of its load that the features of load center distribution may be lost. With advance planning, secondary substations frequently wind up indoors, somewhere above the production floor level.



Westinghouse Electric Corporation

This substation is placed on an overhead balcony in an appliance manufacturing plant. Conduit feeds enter the sub from underneath balcony floor.



General Electric Company

This substation is located on the factory floor right near its loads in Kaiser-Fraser's engine parts plant. The unit is rated 1000 kva. The completely metal enclosed, dead-front construction protects workers from electrical hazards.

System Components

In 90 percent of the secondary substations now in use, interrupter switches rather than breakers are found on transformer primaries. Sometimes the switches are fused, but more often they are not. Faults within the transformer are just not frequent enough to demand immediate primary circuit breaker protection.

Breakers and Switches

The principal advantage of individual primary breakers is their ability to be tied in with protective relaying schemes, but this is too costly for most systems. In primary selective systems, primary breakers are necessary if automatic throwovers are used; however, manual throwovers with disconnect switches are more common.

Some primary interrupter switches are designed for breaking magnetizing current only and must be mechanically interlocked to prevent opening unless the secondary has been opened. Other primary switches are specified for breaking load current and these are widely used; to insure safety, modern practice dictates that the load-break switches should be interlocked with the secondary side, too.

Transformers

As load densities build up, more secondary substations are installed per unit of plant floor area, secondary runs are shorter, and transformers wind up nearer the loads. Hence, light-weight, economical transformers that can be set near loads, indoors without special enclosures, find wide acceptance. Because they fill the bill, askarel-filled and dry-type transformers are gaining favor for indoor secondary substations. They do not require special fire-proof enclosures as do oil-filled transformers, nor are insurance rates as high as when oil-transformers are used indoors.

The dry-type transformer is gaining popularity for new installations. (Some engineers see the trend already reversing back to askarels.) The air-cooled type has limitations in that it can be used only in relatively clean atmospheres away from weather, fumes, and dusts; it must be cleaned regularly. Its maintenance costs, though, are lower than for ordinary liquid-filled types.

Air Cooled Type

The air-cooled dry-type transformer is preferred in secondary selective systems by some plant engineers who feel that they can take moderate, sustained overloads better than sealed dry types or askarel-filled transformers. The air-cooled dry transformer carrying the added load is operated with fans when the other end of the secondary substation is out; it may operate that way (at 150-percent rated load) for several hours or even for a few days. (For momentary overloads, it is widely held that liquid-filled transformers have better thermal capacity.)

The sealed dry-type transformer, operating with nitrogen under slight pressure, is suitable for most indoor applications; dirt in the plant

atmosphere cannot reach it, and maintenance is practically nil. It is steadily gaining popularity though it costs some 20 percent more than the ventilated type.

Light Weight

Both types of dry transformers are comparatively light and are thus suited to the overhead mountings so popular for secondary substations. But a disadvantage of ventilated and sealed dry-type transformers is their comparatively low impulse strength, which precludes their use outdoors, where voltage surges are likely. (To overcome this, units are sold with station-type lightning arresters installed.)

The insulation picture will probably continue to reveal new compounds for higher temperatures, which will replace those that were themselves the last word when introduced a few years ago. Ventilated and sealed-in-nitrogen dry-type transformers are now widely available with Class H insulation; this insulation has a 100-C temperature advantage over the older, more widely used Class B. The ventilated Class H dry-type transformers come in ratings up to 3000 kva and 15 kv; sealed units come rated up to 2000 kva and 15 kv. The glass-like surfaces on internal parts plus the water repellent nature of the silicone bonds and impregnants make the Class H dry-type transformer attractive from a maintenance point of view, too.

Askarel-filled transformers cost the same as Class B dry types, but both cost more than the oil-filled's. The askarels have the problem during internal arcing of maintaining a confined liquid under pressure of toxic gas formations; they must be provided with a gas absorber or vent to avoid gas concentrations.

Secondary Voltages

For secondary voltages, the 480-v level is becoming increasingly popular. In plants already set up with 240 v, there are complications in operation and maintenance which preclude introduction of 480 v for new additions. But in 90 percent of the new plants, 480 v is the choice for secondaries. The principal exceptions are textile plants, which by tradition are served at 600 v.

Part of the reason for the general popularity of the 480-v secondary is the inherent economy of transmitting power at higher voltages. Costs of substations, conductor, switchgear, control equipment, and installation labor all favor 480 v.

But the new, big boost for the 480-v secondary is the increased interest in the 480Y/277-v combined power and lighting system. There is a developing demand for 277 v to serve continuous-row fluorescent lighting. This voltage is derived from the line-to-neutral leg of a 480-v, wye-connected secondary.

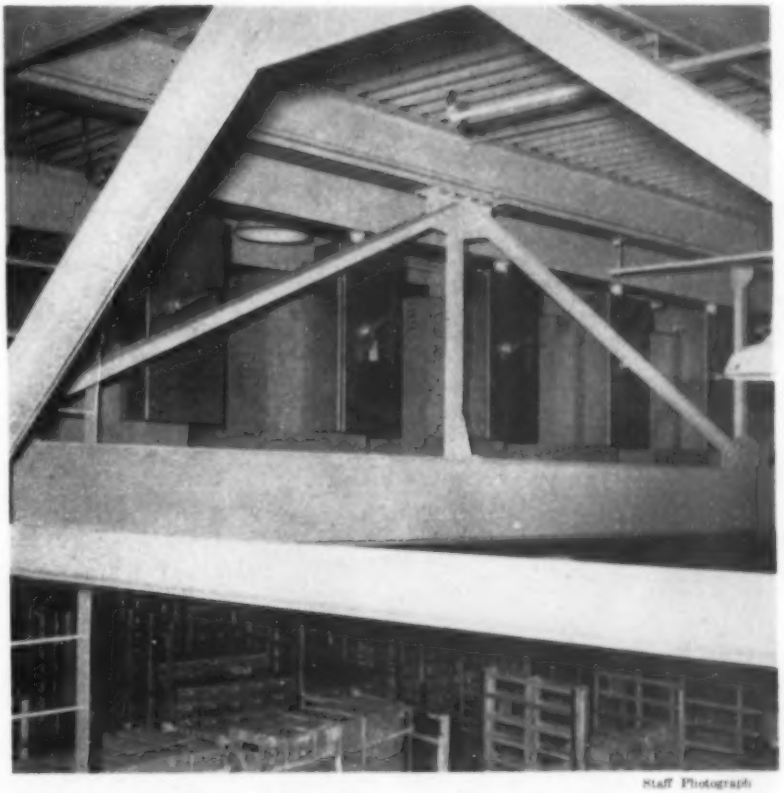
Aside from the inherent advantages of high-voltage lighting, there is a particular advantage in that the sharing of a single circuit improves flexibility, reduces the amount of wiring and transformers required, and takes advantage of load diversity between lighting and power equipment. If, for example, there were separate lighting and power circuits, the next standard rating for a transformer to serve an 1100-kva power load would be 1500 kva while an adjacent lighting system might be drawing 300 kva from a separate transformer. By lumping the lighting and power loads, a single 1500-kva transformer can supply both. (The power load must be checked to be sure that it won't cause disturbing flicker in the connected lighting.)

The advocates of 480Y/277-v systems do have opponents. Armed with data showing that many machine tool motors are over-rated (motors too large for the actual loads) and that they therefore operate at very low power factors, a case is made in some quarters for feeding 440-v motor loads from 416 v to improve the loading and power factor.

The proponents of 416 Y/240-v system do not appear to be hindering wide-spread adoption of the 480Y/277-v system. Perhaps the greatest factor accounting for this is the almost universal eagerness to abandon the 240-v secondary in favor of 480 v for new installations.

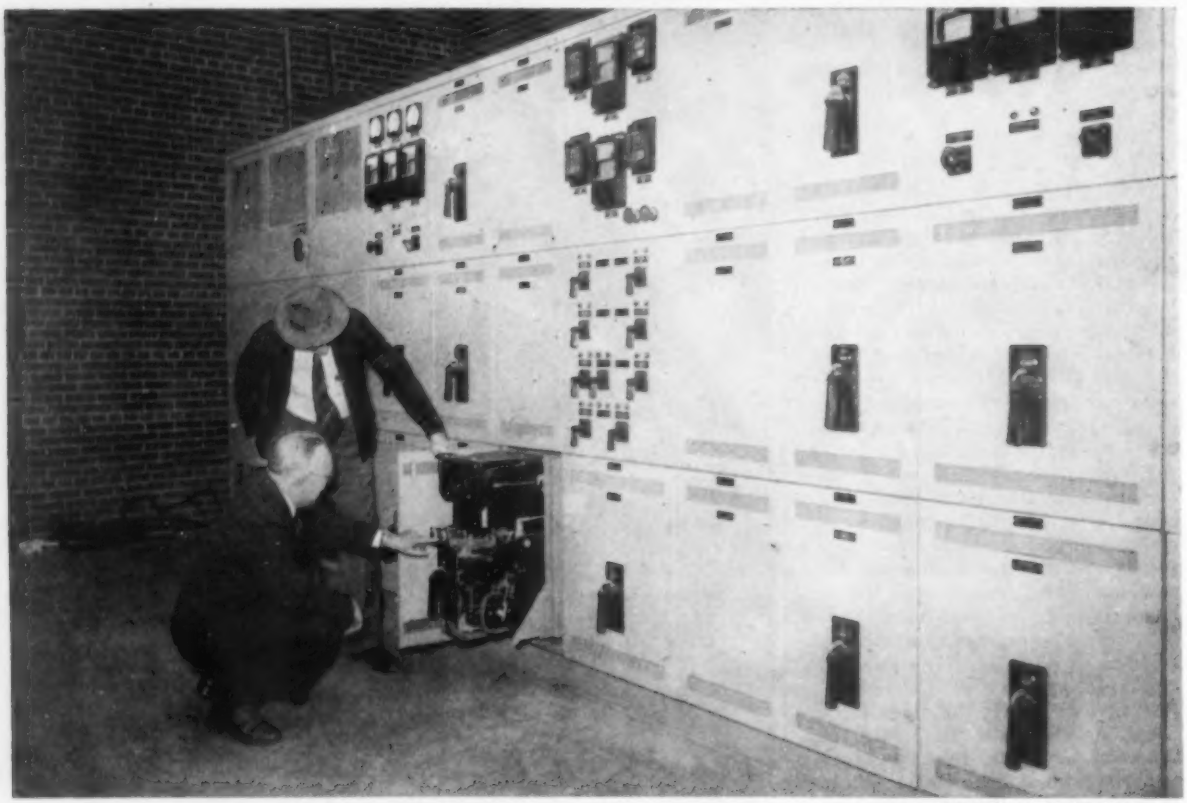
High-Voltage Motors

When motor ratings get into hundreds of horsepower, plant designers start thinking about running direct feeders to the motors



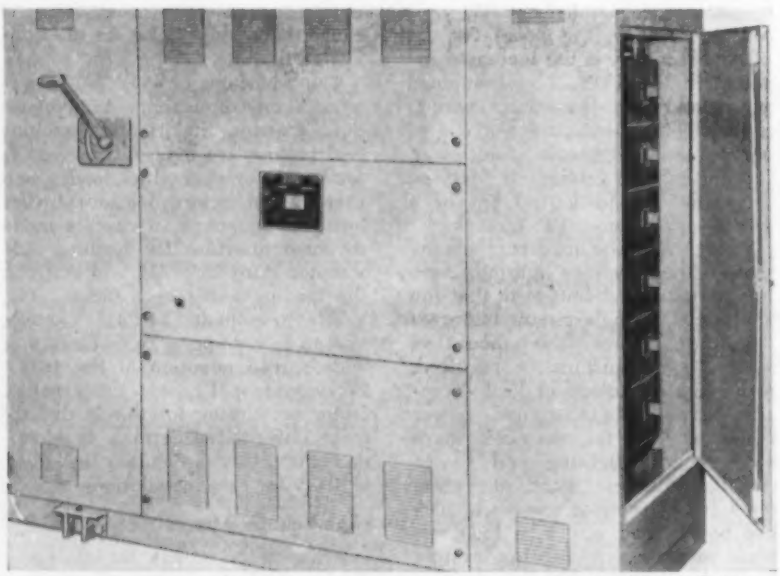
Staff Photograph

These light-weight, air-cooled dry-type transformers hang over storage area in National Biscuit's new Chicago Bakery; they supply lighting power.



I-T-E Circuit Breaker Company

Drawout-type circuit breakers are very popular for secondary substations. Inspection of breaker settings, as done on this 480-v substation, demonstrates how easily the units can be made accessible for inspection and maintenance.



Bergel Electric Company

Molded case breakers are used on the 208Y/120-v secondary of this 300-kva substation. On the primary side there is a 4160-v fused load-break switch.

from the plant's 4160-v (or 2400-v) primary. There is not yet much agreement on the break-even point; some go to high voltage at 75 hp and others wait until the motor rating reaches 500 hp. Many factors can influence the designation of this break-even point in specific cases; most often it lies around 200 hp. But it is now widely agreed that once it is decided to go beyond 480 v, control equipment cost structures dictate going all the way to 4160 v if that voltage is available. In fact, indications are that more and more motors will be sold for 4160-v service and that the minimum horsepower ratings of these motors will be lower than in the past. This means more kva demand can be expected at 4160 v.

Manual Tap Changing

Practically all transformers supplied for secondary substations are equipped with no-load manual tap changing with two 2½-percent steps above and below the nominal voltage rating. Most plant engineers are

tending to rely on utility (or generator) regulation with only occasional attention to the manual tap settings on their secondary substation transformers. There is a growing preference, though, for tap-changing-under-load equipment at the primary substation.

Need for better regulation is growing due to the increased use of electronic and similar voltage-critical devices. For the most part, regulated voltage for such devices is provided by circuitry within the device or by locally applied stabilizing transformers. Where the device has a special power source, it often has its own voltage adjustment.

Secondary Breakers

Drawout-type air circuit breakers are generally preferred over molded-case breakers for the low-voltage side of secondary substations because of their more rugged construction. They can stand frequent operation, can be cascaded with safety, and are felt by some to be more accurate. But since molded-case breakers have been announced with interrupting capacities up to 40,000 a, they have found some application in light-duty substations up to 500 kva; molded-case breakers remain popular for panel boards and branch circuits. In general, there is a clearer understanding today of the interrupting capacity rating of circuit breakers, and there is an increased tendency to provide interrupting capacity for full three-phase fault current.

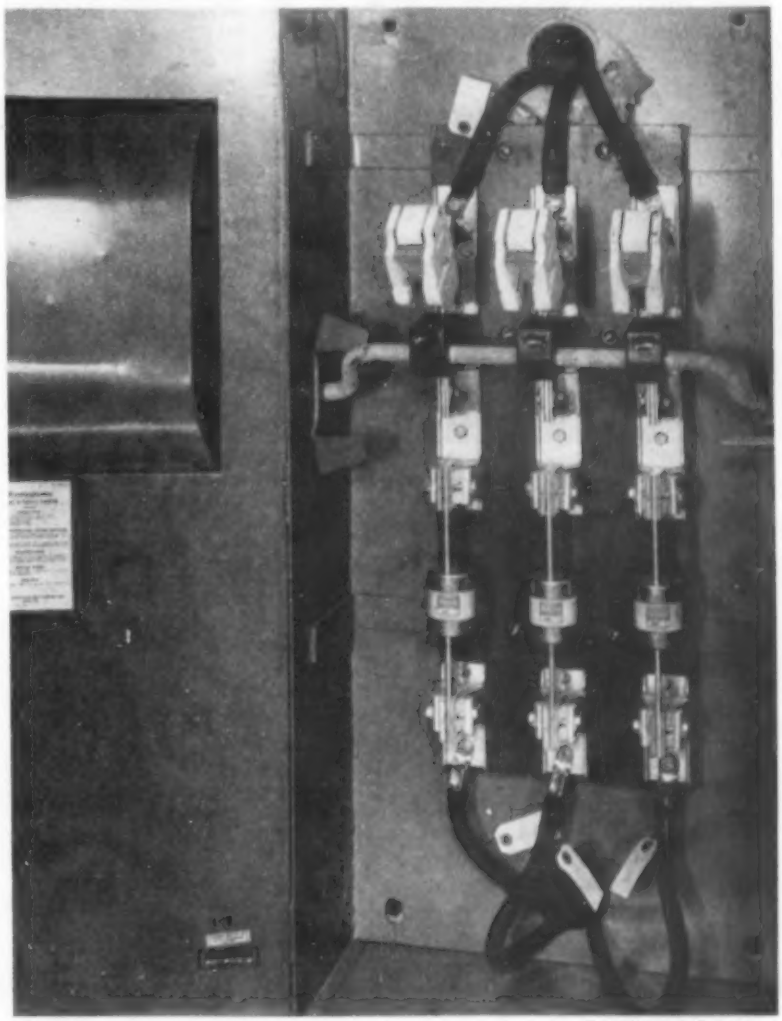
Breaker Coordination

Improvements in switchgear are prompting re-evaluations of cascade tripping as opposed to selective tripping systems. In selective tripping, each breaker from source to load is designed to interrupt the maximum fault current available at its position in the circuit; the time-current characterstic of each breaker is selected such that the breaker nearest a given fault can, and will, trip out upon the fault. In cascade tripping, only breakers nearest the source have full interrupting capacity. The ones farther away have something less than the full capacity to interrupt full maximum fault current available at their position in the circuit; these are therefore cheaper than the full-rated breaker which selective tripping would demand in that spot. The cascade system depends on breakers near the source for full back-up protection of breakers near the load. Thus, the cascade system can use breakers having less interrupting capacity and which are thus less expensive, but it does not guarantee that the breaker nearest a fault will be the one to trip.

There was a comparatively high cost placed on selective tripping back when such a system required instrument transformers, relays, separate sources of power, and the extra circuitry that goes along with these components. Much maintenance, too, was involved.

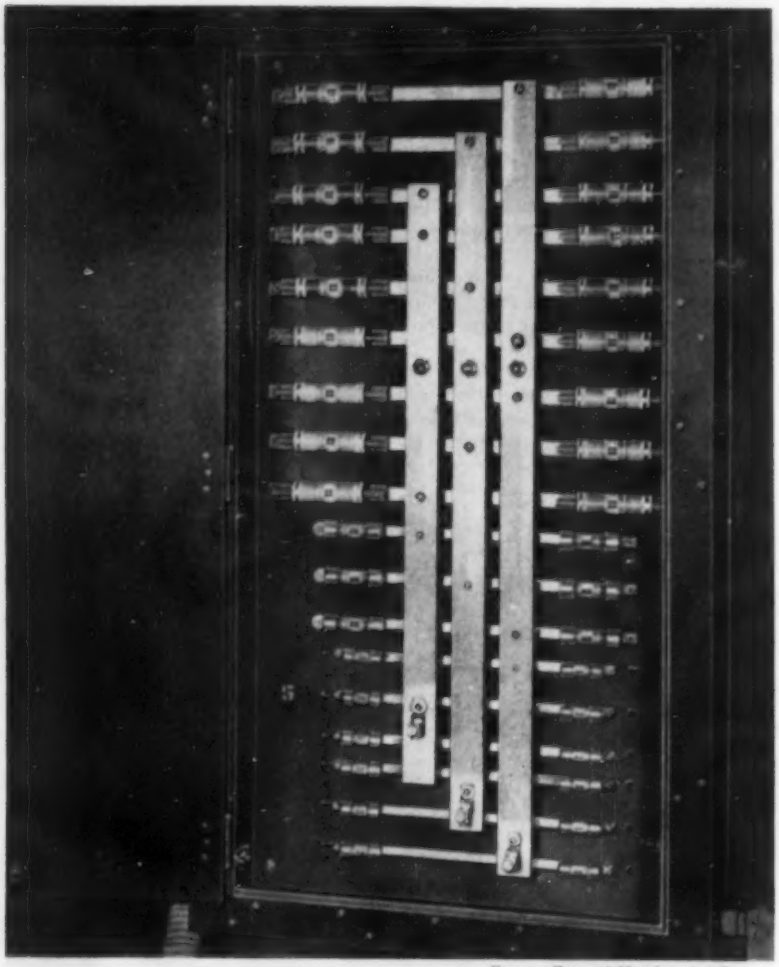
Since selective tripping now can be accomplished by using the new well-defined time-current characteristic of the breakers themselves, external relaying no longer enters the picture. Installations which previously might have ruled out selective tripping, because it cost too much even for the advantages afforded, now find that the cost spread is not as great and that selective tripping comes within the budget more easily.

Nonetheless, cascading remains cheaper though it is still widely recognized that it does not give as good service continuity. Cascade tripping is permissible if the plant can risk letting its main breaker trip on a branch circuit fault, and if the main breaker and branch breakers can be allowed to remain open until an electrician can properly reclose them. But where an outage from a fault must be confined to as



Chase-Shawmut Company

This safety switch is part of a welder control in use at a California aviation plant. The fuses are the current-limiting type, used to interrupt heavy faults.



Economy Fuse and Manufacturing Co.

This enclosed box has ferrule-type fuses of several sizes for various loads. Fuses are widely specified by engineers for protection of branch circuits.

small a plant area as possible, selective tripping insures that the breaker nearest the fault will trip.

Fuses

The growth of industrial systems has resulted in the possibility of increasingly large available short-circuit currents. This accounts for the great interest in the class of fuses designated as current-limiting fuses. They are made of fusible elements fashioned out of silver, surrounded by quartz sand, and encased in an impregnated fiber glass tube. Their limiting ability stems from the very fast interruption they provide when rates of current rise are quite high, such as develop during faults of great available amperage.

Most of the current-limiting fuses are rated 100,000 rms-a interrupting capacity. For example, one current-limiting fuse rated 500 a opened against a 200,000-available-ampere surge with a let-through current of only 49,000 a. For a given available current, a current-limiting fuse having a larger load rating will allow larger let-through currents before actually completing its interruption, but the current-limiting function is quite well maintained in sizes up to 5000 a, continuous, at 600 v.

The current-limiting fuse has its principal application where economical short-circuit protection is desired and where ordinary fuses do not afford sufficient interrupting capacity: breaker back-up protection, heavy branch feeders, lighting circuits, motor starters, load centers, and the like. Under normal overload, there is no steep rate of current rise and the time-current characteristic of the current-limiting fuse is such that single- or dual-element fuses nearer the load would interrupt first. A completely coordinated system thus can be set up using fuses alone.

Renewable fuses offer economical branch and feeder circuit protection against large overloads and short circuits. Dual-element fuses are used widely to protect motors against overloads and single-phasing; they also are used to protect against short circuits on motor branch lines. The time-current characteristics of the fuses in each phase at any given application should be closely matched by using the same brand and size in all three phases; otherwise there is the possibility of single-phasing, i. e. one fuse alone blowing.

Generally, there is a trend back to fuses because of their economy and because the newer types are providing better coordination and protection. Branch circuits are more likely to be fused, though load centers still widely use circuit breakers.

The circuit breaker is certainly not going out of the picture by any means. Breakers are still generally used where service must be restored quickly, where frequent interruptions are expected (and where workers can be allowed to restore service), and where switching functions are involved.

Thermal Alarms

In continuous process plants, where outages are extremely expensive, there is some demand for thermal alarms to warn of overloads instead of having a shutdown by a breaker trip-out or fuse interruption. Short-circuit and fault protection is provided, but the alarm permits a warning in event of mere overload without loss of production or expensive cleanup and downtime. Along the same line, there is an ammeter available which integrates the product of time and the square of the line current, giving an indication of heating.

Primary Wiring

There is a definite trend away from lead-sheathed cable. For outdoor, between-buildings primary wiring, there is some preference for underground lines, using non-

metallic sheathed, neoprene jacketed, rubber-like-insulated conductor in duct buried in concrete. Asbestos or impregnated fiber duct is satisfactory for most applications except where the duct would run under areas sustaining exceptionally heavy mechanical loads from above. Low-voltage power and control cables are being installed with direct-burial parkway cable.

Without adequate planning of cable layout, underground installations may require derating for multiple runs because of heat accumulations. The underground system is more costly than the overhead and it is harder to repair or tap. It does afford better reliability in a great many cases, which very often is most important.

Overhead Cable

Though overhead cable is cheaper to install than underground lines, it is more hazardous, less reliable, and more subject to mechanical and lightning damage. The newer, preassembled overhead cables are quite an improvement compared to the older open wiring; the preassembled aerial cable is finding favor among a great many engineers.

For indoor primary service, preference seems to be developing for interlocked-armored cable. Savings of 30 percent are reported by using armored cable instead of wire in conduit on long, large-current runs where the cable can be strung along the building's trusses. Armored cable can be strung with relative ease and has a high degree of salvageability. Conduit installations are plagued with high installation costs for cutting, fitting, reaming, threading, and pulling.

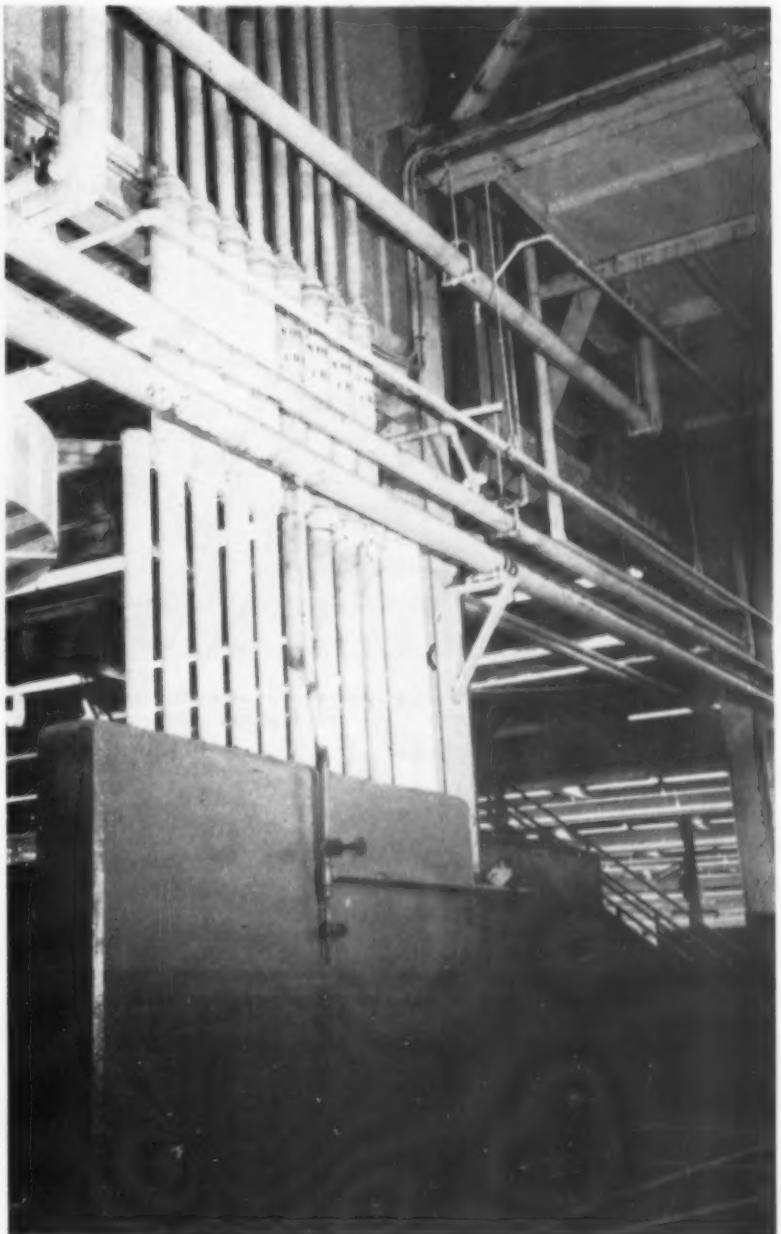
Where very large primary currents are carried indoors and the number of cables per phase exceeds two, there is some advantage in the use of bus. The installation labor, the complexity in making taps, and the bulk of the cable makes the use of bus seem more attractive in such instances.

Secondary Wiring

For bulk distribution of large power blocks at secondary voltages, there is a choice between feeder bus duct and wire in conduit (conventional or thin-wall). The distances involved in modern installations are becoming shorter, and the ruling factor often becomes one of flexibility. If the plant is likely to experience changes in the future, feeder bus duct is more likely to be the choice; low reactance feeder duct is becoming more popular on account of its low voltage drop.

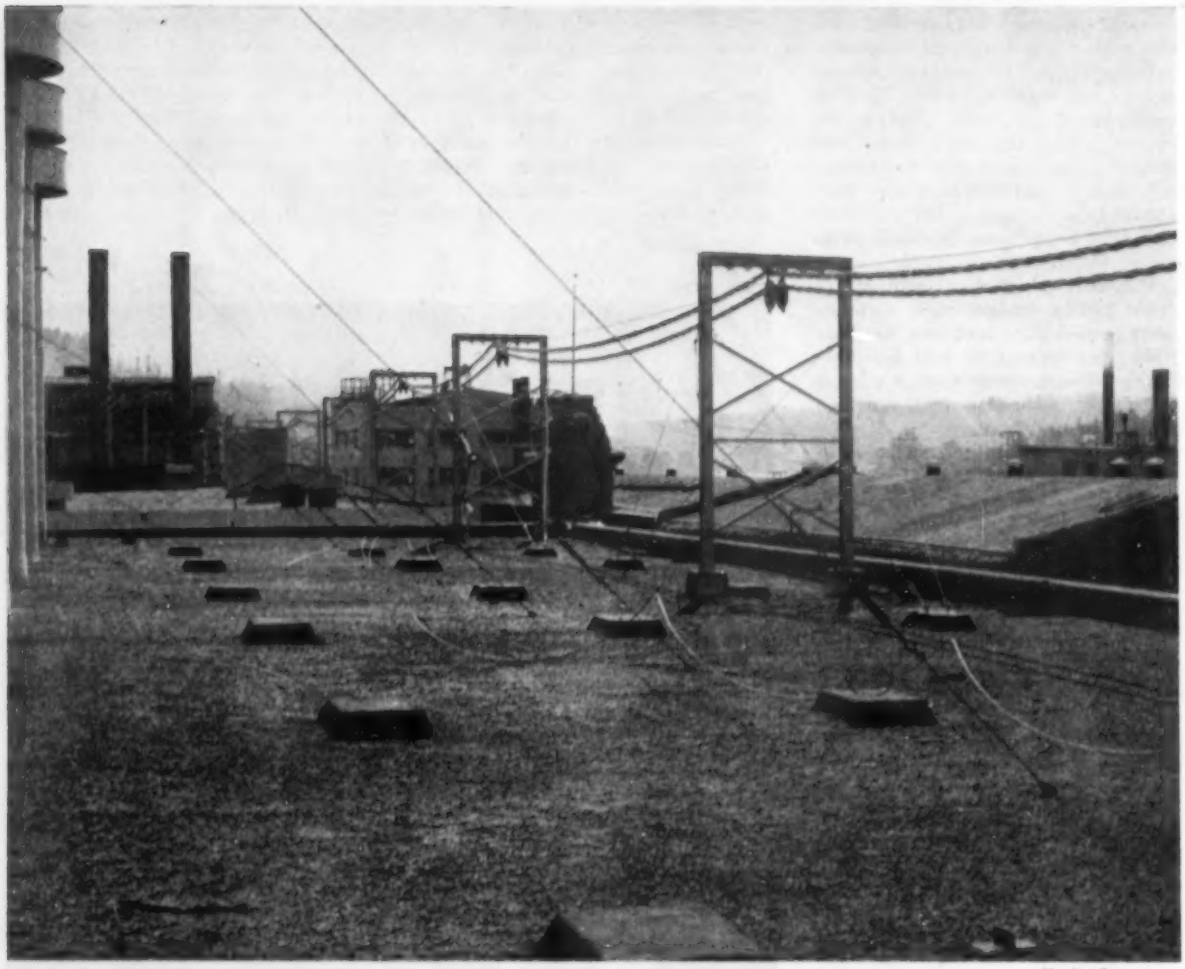
Considering the distribution system nearest the utilization devices, there is no doubt that plug-in bus duct is becoming more and more popular, especially where closely spaced utilization devices demand frequent tap-offs. Material costs are higher than for wire or cable for a given installation, but the labor to install duct is much less. Over-all costs most often favor bus duct.

Flexibility is of primary importance. In areas where machines are



Caterpillar Tractor Co.

Underground 12-kv, paper-lead primary cables enter plant through risers; transition to varnished-cambric armor cable is made through splice sleeves.



Okonite Company

This outdoor cable is being installed over the roof of an Oregon paper plant. One cable is in place, the other is still being installed. The cables are three-conductor, 500-mcm aluminum, self-supporting, rated for 5-kv service.

likely to be moved, the plug-in features available with bus duct become most attractive. Entire runs of duct can be taken down and reinstalled where needed with no loss of material. Further flexibility is afforded by the many system accessories for plug-in duct; there are fused tap-offs, circuit breaker tap-offs, plug-in capacitors for local power factor correction, grounded-phase indicators, and tap boxes.

Part of the poor salvageability inherent in conduit systems is eliminated, if cable diameters are not too large, by using straight runs of conduit with fittings installed at all taps and changes in direction of the runs. Thus the entire system is put together like an Erector set and is taken apart in much the same way. Thin-wall electrical metallic tubing (E. M. T.) continues to find wide favor; its light weight, ease of bending, and quick installation also give it some measure of flexibility and salvageability.

Plug-in Loads

There is another consideration, related to the type of equipment being served. Machine tools are usually furnished by manufacturers with starting equipment already in place; such tools are often just skidded into position and then merely plugged in. Here, plug-in duct makes power conveniently available.

On the other hand, when the plant area contains a large number of pumps or other apparatus not provided with starting equipment by the manufacturer, motor control centers are most likely to be set up and then individual wire or cable feeds are installed to supply the motors. The control center itself is more likely to be fed by wire in conduit from the secondary substation than by bus duct.

Where enclosure problems exist, duct generally cannot compete with wire or cable protected by conduit, sheathing, or armor; these fully enclosed conductors must be used if a plant is to be washed down frequently with hoses, or has an atmosphere containing lint, corrosive fumes, hazardous vapors, gases, or dusts. Conduit and E.M.T. are available with exterior polyethylene films for particular, corrosive atmospheres. Mineral-insulated con-

ductors are becoming increasingly popular for specific locations plagued with contaminants.

For loads that are continually shifting over limited areas—such as lighting fixtures, cranes, hoists, and portable tools and machines—trolley duct is finding wide application. It has the advantages of bus duct, but provides an additional degree of freedom in permitting considerable movement of the utilization device.

Conductor Materials

In addition to the matter of conductor form, conductor materials are subject to much current review. There is no doubt that aluminum is making inroads as a conductor material. The electrical industry now uses about 250 million pounds yearly; this is expected to double within 5 years. (Part of this increase will follow from the persistent growth pattern of the industry—doubling every 8 or 10 years.) Aluminum has been in use for many years in some particular applications; these are characteristically long runs carrying heavy currents in certain corrosive atmospheres.

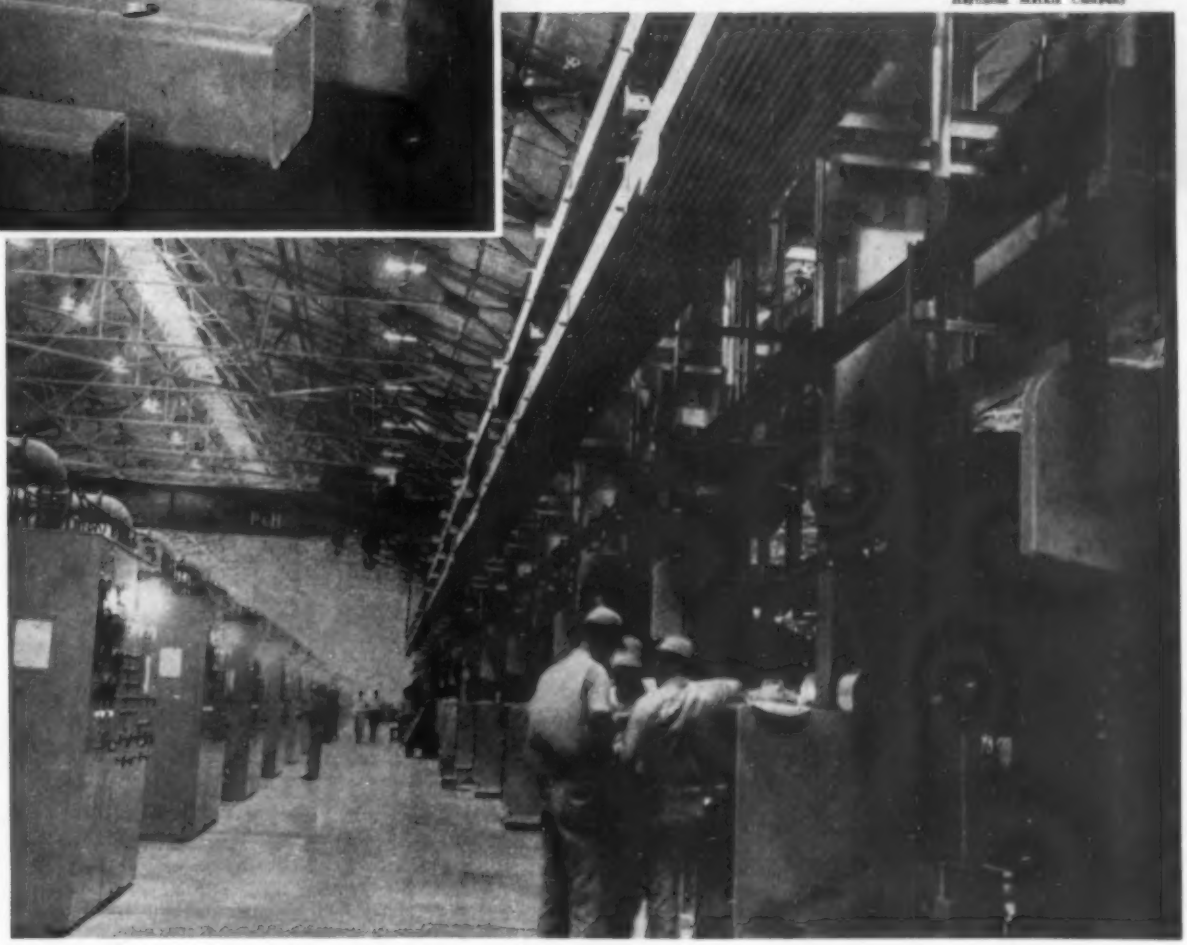
Late catalogs from wire manufacturers show insulated aluminum conductor for industrial wiring to be cheaper than copper wire of equal current-carrying capacity. Of course, where crowded duct is concerned, the extra diameter of the aluminum conductor may call for a larger size duct, at extra cost. This may wipe out whatever price advantage might have existed on the basis of conductor price alone.

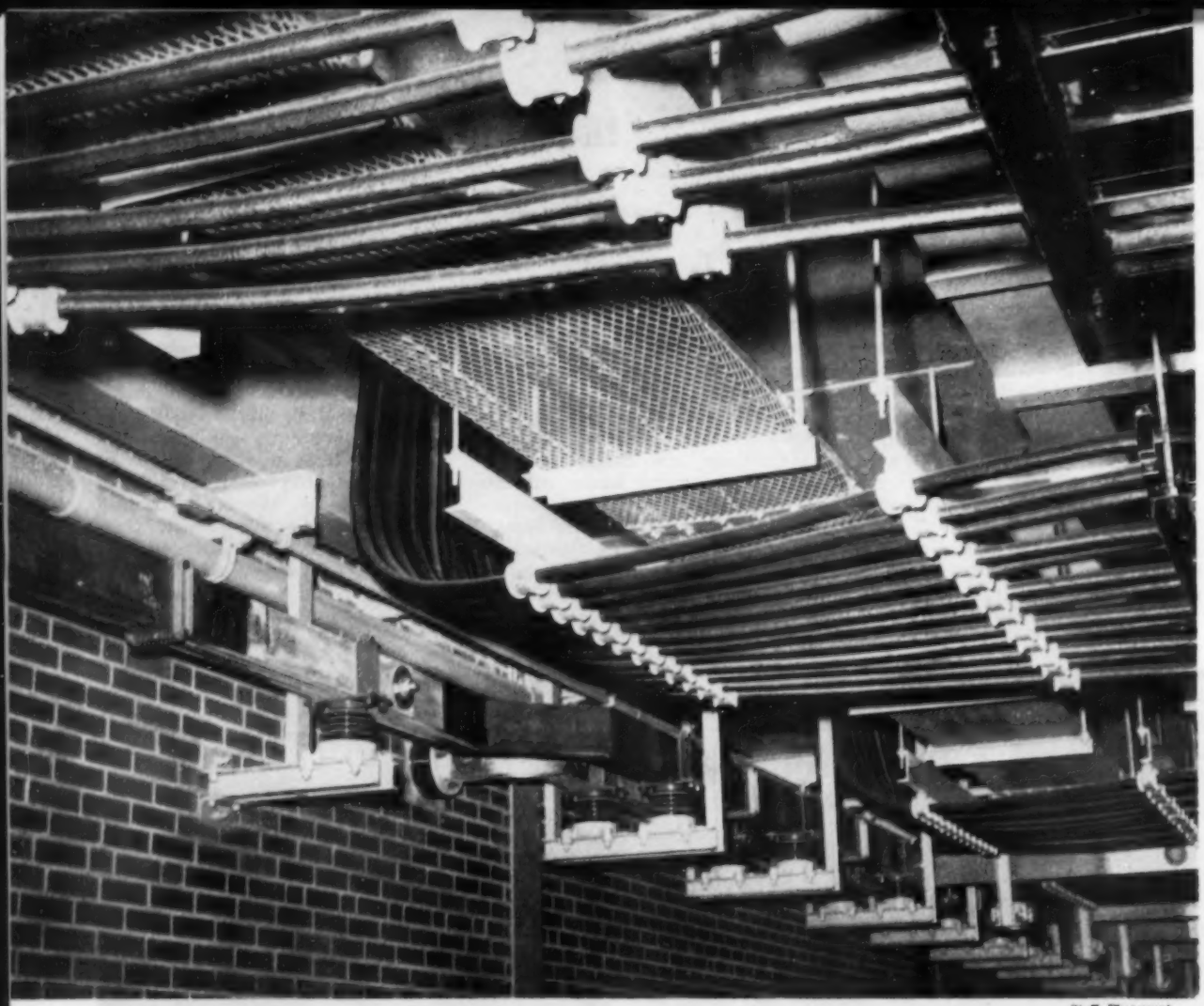
But where space considerations are not critical, aluminum is coming in. Aluminum-conductor bus duct is selling at 8- to 10-percent less (installed) than equivalent copper for an "average" industrial installation. At the present time, it is estimated that 5 percent of the bus duct sold uses aluminum conductor; within 2 years this is ex-

American Brass Company

Copper bus (left) is available in many shapes and is widely used. Aluminum bus (below) is part of what is reputed to be the world's largest installation of aluminum bus; the bus system handles 100,000 a, dc, in an aluminum reduction mill.

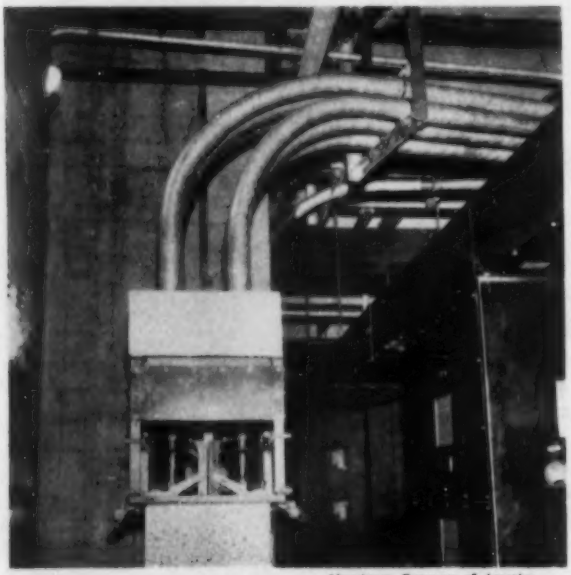
Reynolds Metals Company





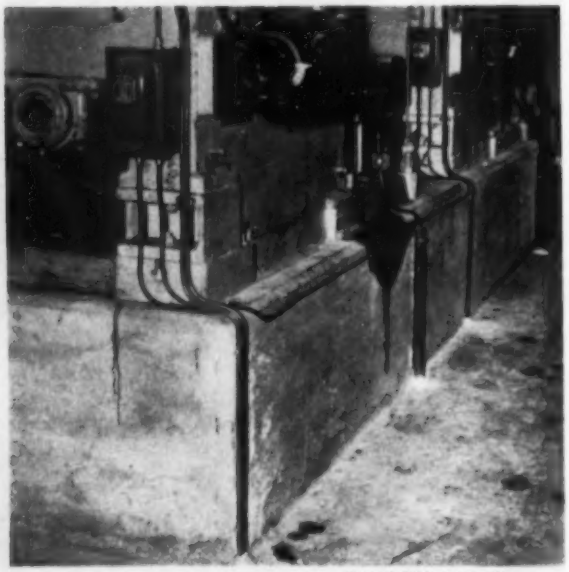
Staff Photograph

Pennsylvania Salt's Calvert City, Ky., plant makes good use of many conductor forms; in the rectifier house they use the several forms shown here, including wire-in-conduit (above the open copper bus) and control wire in trays.



Aluminum Company of America

This aluminum conduit runs from substation floor to switchgear, in Irwin Works of United States Steel.



General Cable Corporation

Canadian paper mill uses this mineral-insulated wiring, running it right into the concrete floor.

pected to rise to 15 percent, and in 5 years it may be 25 percent.

The lightness of aluminum duct can be an appreciable advantage. For long vertical runs or where duct is hung from light trusses, the light weight of aluminum may be appreciated.

Inertia

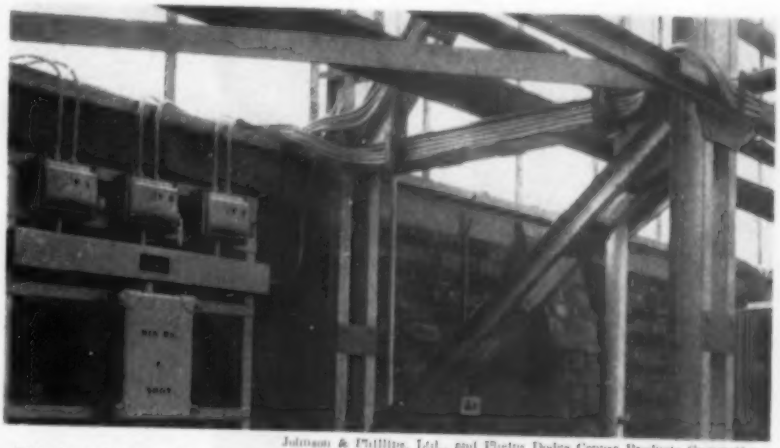
Wider use of aluminum faces the task of overcoming the inertia within engineers who are "used" to working with copper. Admittedly, there have been misapplications of aluminum within recent years. One major drawback which has been gaining notice is the matter of terminations. Aluminum will "cold flow" under the normal contact pressures of ordinary connections, causing the mechanical connection to loosen. Both modern connectors for aluminum and modern techniques are now available so that electrical-conductor-grade aluminum can be satisfactorily joined by welding, soldering, bolting, and crimping. (One source will soon announce a new, improved grade of aluminum for electrical conductor; it will undoubtedly be more amenable to terminating.) Silver plating of contact surfaces is becoming more common; one brand of plug-in bus duct is plated over its entire length.

A "chicken-or-the-egg" situation exists in that equipment manufacturers say they would put terminals compatible with both copper and aluminum on their equipment if there was any likelihood that their equipment would be hooked up to aluminum conductor. On the other hand, users say they would use aluminum conductor if equipment was provided with terminals which would take it. This stalemate is slowly being resolved because many manufacturers are beginning to install terminations on their equipment which will take aluminum or copper. And adapters are available to join aluminum and copper conductors directly.

Aluminum Structures

Aluminum is also pressing steel and galvanized iron in the fabrication of such things as outdoor substations and cable trays. Aluminum substation structures may initially cost up to twice as much as galvanized iron, but they require far less maintenance in most corrosive industrial atmospheres.

Aluminum holds up indefinitely



Johnson & Phillips, Ltd., and Phelps Dodge Copper Products Corporation

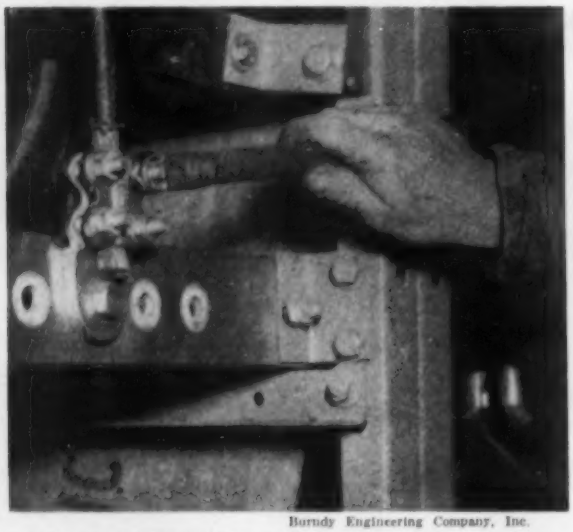
This installation of aluminum-sheathed cable in England demonstrates the way in which the cable can be snaked in and around building structures without harm.

Bullfog Electric Products Co.

This automobile plant uses trolley busway overhead to power hoists; power is thus available throughout operating area of hoists without dangling wires.

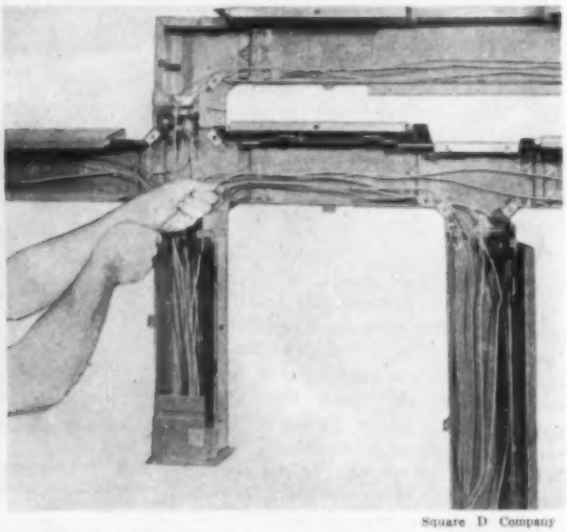
Walter Kidde Constructors, Inc.

In this welding area, the welders are likely to be moved at any time; plug-in bus duct lends the appropriate measure of power service flexibility desired.



Burndy Engineering Company, Inc.

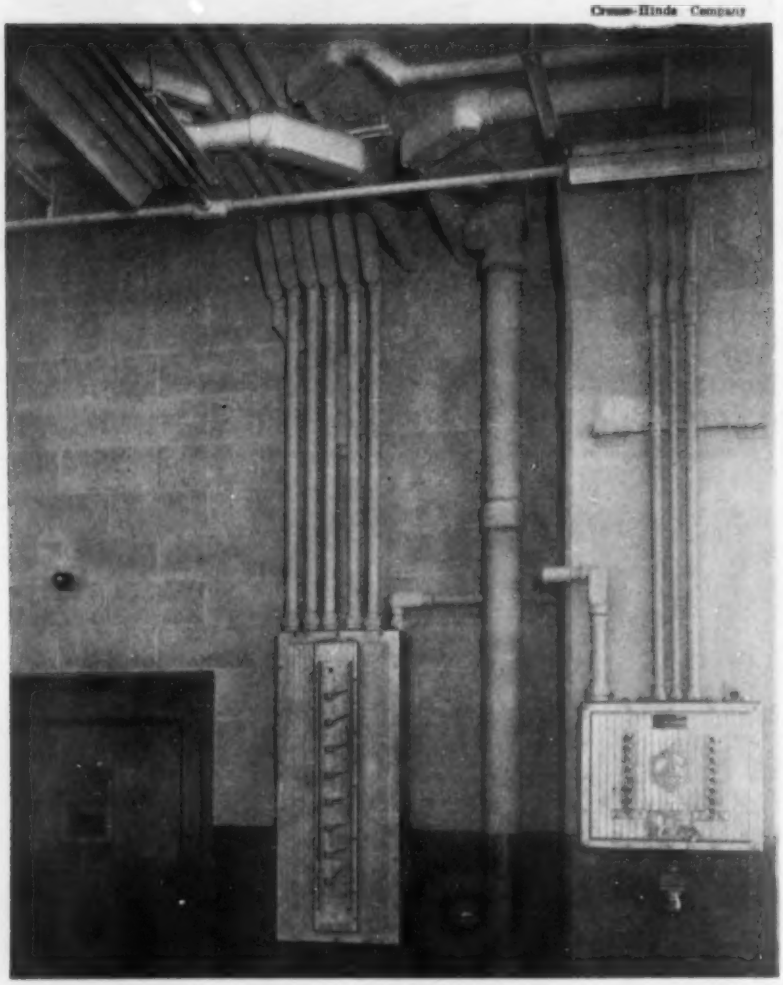
This connector is being used to join a circuit breaker bus made of copper to a 600-mcm all-aluminum cable.



Square D Company

Wiring for feeders and branch circuits can be dropped into this steel wiring trough; hinged covers close it up.

Crouse-Hinds Company



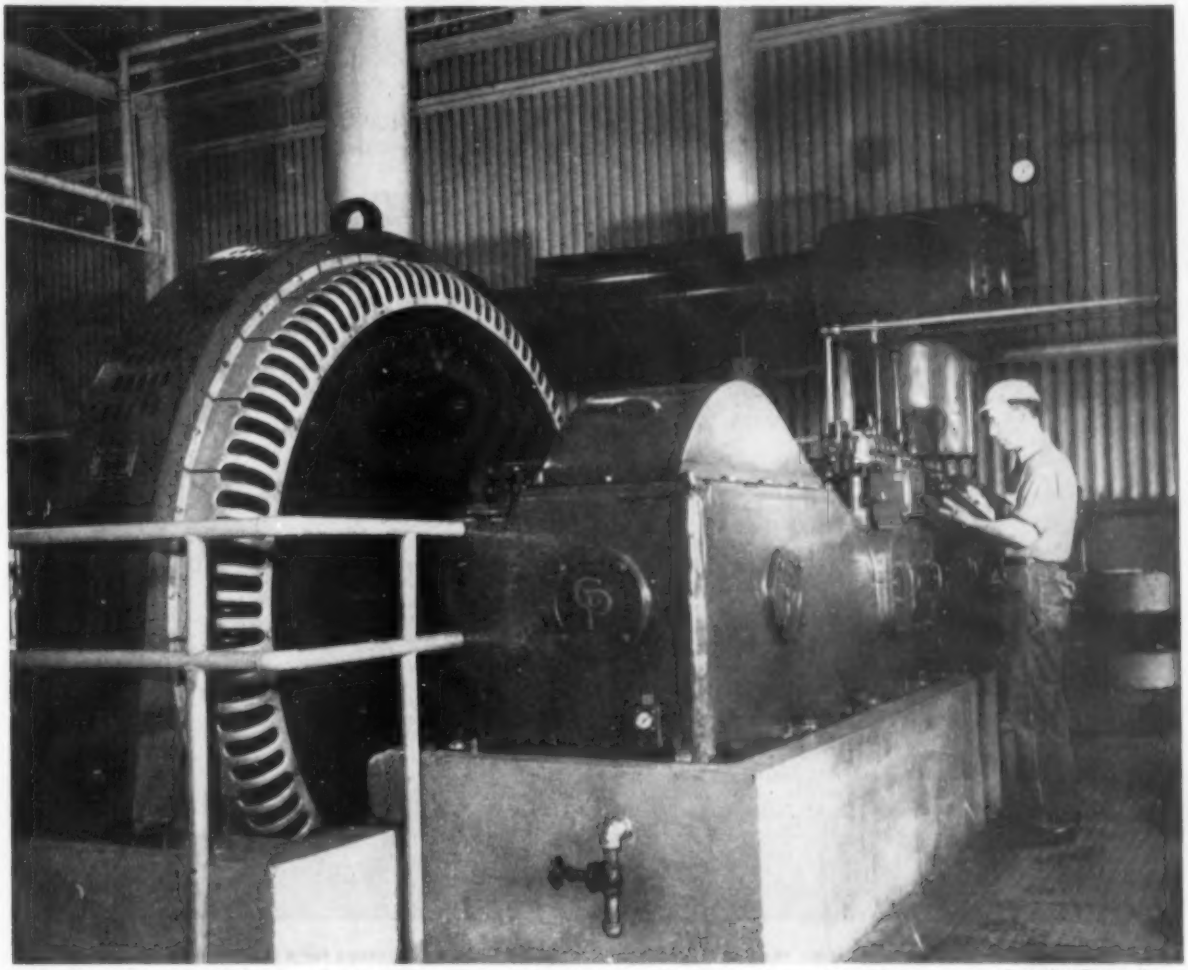
in certain corrosive atmospheres and therefore has long been used for conduit in some chemical and food plants. But polyethylene-coated steel conduit and thin-wall is becoming popular for many corrosive applications—including some that aluminum can't tolerate. Trial installations using plastic coverings over steel-, aluminum-, and bronze-armored cables in corrosive atmospheres have been made, too; this seems to be the answer to many corrosion problems.

Cable Sheath

Cable sheathed in aluminum will be making its appearance in quantity within a year. It is already being used in place of cable in conduit in European and Canadian plants.

One American firm has just announced the importation of an extrusion press for sheathing cable with aluminum. By next Spring, their aluminum-sheathed cable will be available in the same general types as are now available with a lead sheath; extruded aluminum will merely replace the lead. There is the possibility, too, that some manufacturers will combine an aluminum sheath with silicone insulations to produce a cable capable of operation up to 200 C.

A wide variety of fittings for conduit systems improves salvageability and flexibility greatly.



Caterpillar Tractor Co.

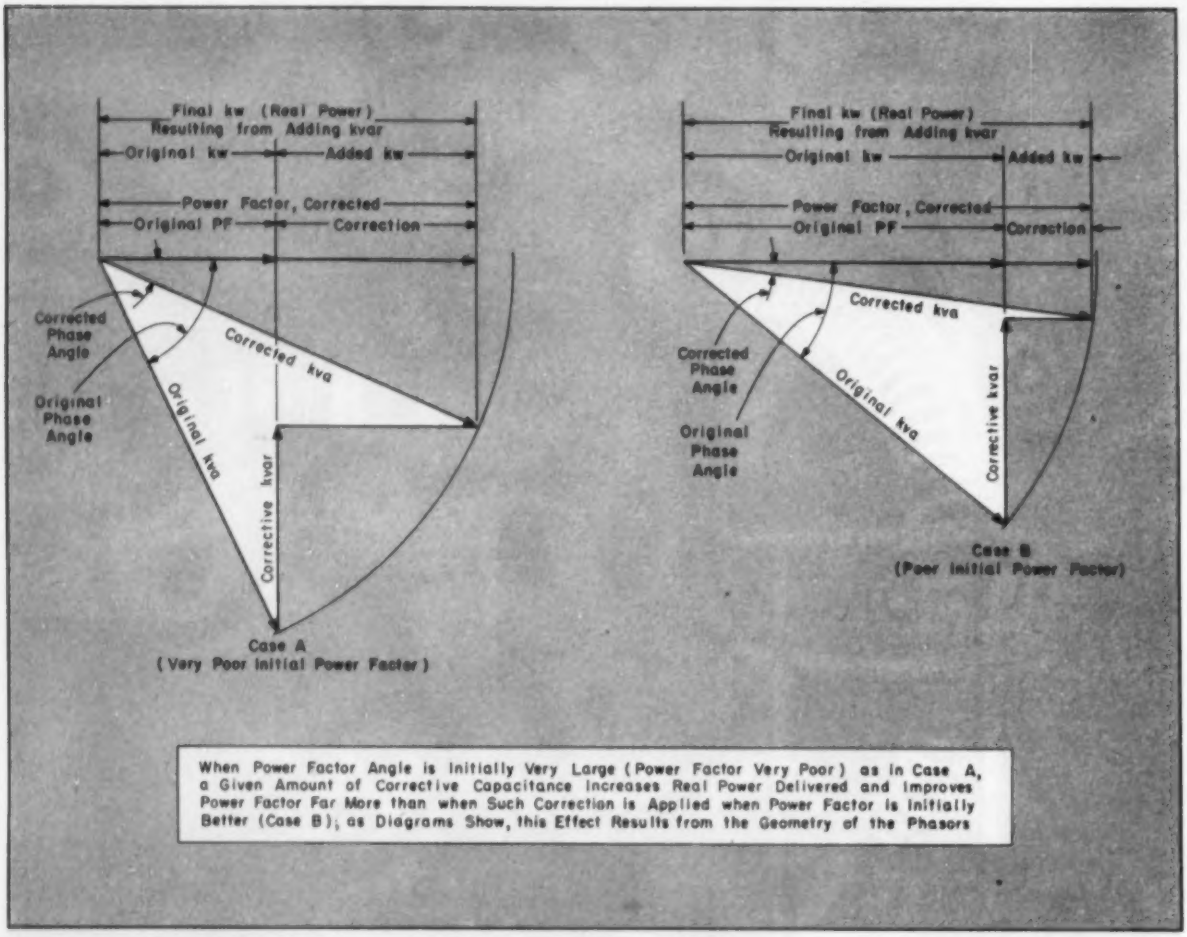
This 4000-v, 600-hp synchronous motor drives an air compressor; excitation on the motor is set so that the motor operates at 0.8 leading power factor. Using two such units, this modern plant keeps its power factor well over 0.90.

Power Factor

All users of electric power pay for the losses accompanying low power factor. Utilities may make separate charges based on actual power factor, they may make rebates for improved power factor, or the costs they bear in connection with poor power factor may not show up directly in the customer's bill. Poor power factor is always costly whether the costs are directly billed by the utility or not, or whether all power (including losses) is generated within the plant. There is a point of diminishing returns beyond which it may cost more to correct the power factor than to suffer the penalty. The position of the break-even point for a given plant depends on its rate structure (or generator loading) and the initial load characteristics. Most utilities penalize for any power factor under 0.85; some impose special charges for anything under 1.0 pf.

Low power factor is becoming less of a problem because the nature of typical plant loads is changing; power factor correction within utilization devices is coming into more general use. For example, modern welding equipment now is most often furnished by manufacturers with power factor correction capacitors as part of the equipment.

Synchronous motors, operated at about 0.8 leading power factor, are now becoming more widely used in new plants. They furnish correction at the same time that they drive devices such as refrigeration compressors, log chippers, d-c generators, or air compressors. For constant, low-speed loads over 100 hp, synchronous motors can be considered economical for the extra advantage they afford in power factor correction; for high-speed loads, the minimum may go as high as 600 hp. But many plant designers


Final kw (Real Power) Resulting from Adding kvar
Original kw
Added kw
Power Factor, Corrected
Original PF
Correction
Corrected Phase Angle
Original Phase Angle
Corrected kva
Original kva
Corrective kvar
Case A
(Very Poor Initial Power Factor)
Final kw (Real Power) Resulting from Adding kvar
Original kw
Added kw
Power Factor, Corrected
Original PF
Correction
Corrected kva
Corrected Phase Angle
Original kva
Original Phase Angle
Corrective kvar
Case B
(Poor Initial Power Factor)
When Power Factor Angle is Initially Very Large (Power Factor Very Poor) as in Case A, a Given Amount of Corrective Capacitance Increases Real Power Delivered and Improves Power Factor Far More than when Such Correction is Applied when Power Factor is Initially Better (Case B); as Diagrams Show, this Effect Results from the Geometry of the Phasors

Improving power factor results in more real, work-producing power (kw) being delivered for a given amount of kva. If the amount of real power were held constant, improving the power factor would reduce the kva (and line losses) required.

prefer to study each case individually rather than abide by any blanket rule.

Capacitors

Capacitors can be used in banks on feeders to correct power factor in bulk, or they can be placed at offending devices and perhaps individually switched on and off with them. There is not widespread agreement as to whether correction of power factor is most advantageous by bulk correction of feeders or by individual correction of utilization devices. Among the factors to be considered in any specific case are the following:

¶ Costs of the capacitors themselves as well as installation costs may or may not be higher per kvar for distributed capacitors than for bulk installations.

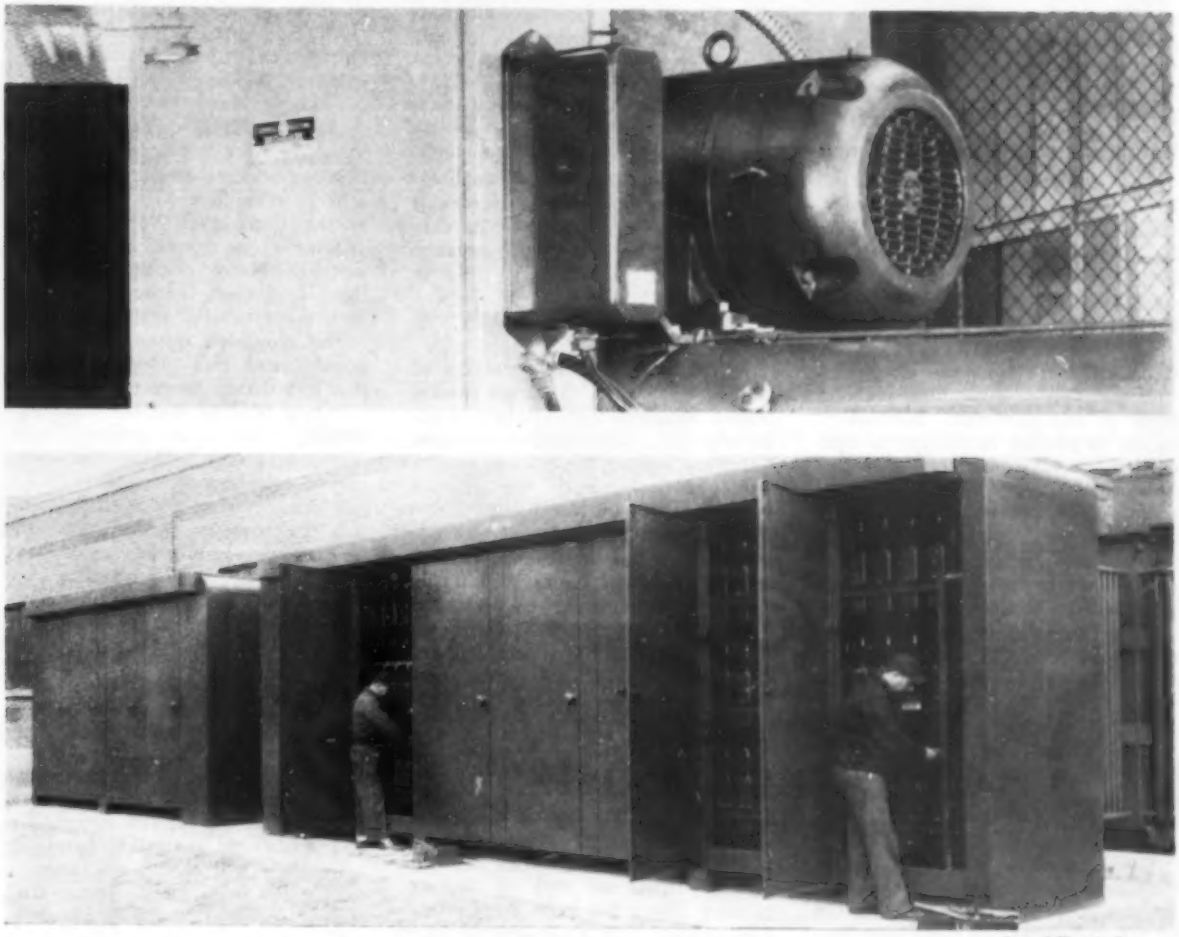
¶ Since not all devices are on at the same time, the diversity of the load permits equivalent correction in bulk with less total capacitor kvar. On the other hand, bulk installations on feeders can not be switched on and off with individual loads; during light loads, too much kvar from bulk capacitors can result in "over-correction." Switching arrangements to overcome this difficulty would add to the cost of bulk-installed capacitors.

¶ Maintenance may be more difficult on scattered units than on capacitors grouped in a few locations.

¶ Since substations are being installed closer to loads today, lines are shortened. Thus, for a given load, line losses due to poor power factor—being proportional to line length—are already materially reduced; the principal advantage in using distributed capacitors (reducing line losses) is thereby negated to some extent since shortening the lines has already reduced line losses.

Switched Capacitors

Of the bulk capacitors going in, fewer are being used with automatic switching arrangements. But when something more sophisticated than manual switching is necessary to insure protection during light loads, automatic switching can protect against over-voltages, excessive leading currents, and leading power factor which may instigate action under a penalty clause by the utility or which may cause instability in the plant generators. Automatic switching may be arranged to respond to time or to circuit voltage, current, or kilovars.



General Electric Co.

Three-phase, 6-kva, 460-v capacitor is mounted on motor starter (above) for power factor correction; capacitor is switched with motor. Outdoor bank (below) for bulk correction of plant load is rated 7800 kvar at 13.8 kv.

Grounding System Neutrals

There is a trend toward increased use of the grounded neutral system for industrial distribution systems. About 80 percent of the plants now in operation use the ungrounded system, but some 50 percent of those now being built (or recently completed) are going in with the neutral grounded.

While preference for grounded systems is increasing, it is by no means unanimous. There are several items of debate which are often cited in the controversey over neutral grounding. But perhaps the one heard most frequently centers on system outages as related to grounded phases. In the grounded system, a grounded phase immediately takes the grounded circuit out of service. The plant staff must be prepared—is indeed forced—to immediately attend to the ground in order to restore service. The ground is fairly easily located since the affected circuit is dead.

But many plants would like to avoid outages whenever possible and would prefer to repair grounded phases during normal off-hours. The ungrounded system does permit operation with one phase grounded; a single grounded phase will not take the circuit out. But if a second ground develops on another phase, all affected circuits will go out. It is much harder to locate the grounds under such conditions than when a single ground exists on a grounded system.

Grounded-Phase Indicators

To reduce outages on an ungrounded system, grounded-phase indicators can be installed through-

out the plant to show when a ground develops; consequently, the ungrounded system demands constant policing to catch a single-phase ground before another develops.

Service Continuity

The grounded system, therefore, is the one which demands immediate attention to grounds since there is an immediate outage; the ungrounded system permits continued operation with a single-phase ground although a second ground means worse trouble if it should develop before the first is cleared. The question of grounding resolves itself in any particular installation, as far as service continuity is concerned, if it can be decided which is more desirable—continued operation under single-phase ground with the risk of more serious trouble later, or suffering more frequent outages which force immediate attention to all grounded phases.

Since service continuity is the important item in comparing the systems, plant housekeeping can be the determining factor in the success of either system. The ungrounded system demands conscientious attention to the grounded-phase indicators and immediate clearing of a single-phase ground before another can develop. The grounded system demands fast action on a ground to restore service quickly. As yet, no significant data is available as to which system leads to most total outage time in a year.

Other Considerations

In addition to considerations of service continuity, there are several others. Safety is one. While it is acknowledged that transient voltages, lightning surges, switching surges, and phase voltages under fault are less severe with the grounded system, there is not wide agreement as to the importance of this aspect of the problem. Within the range of voltages to be expected under fault or normal conditions, it is felt by many that the voltages available in either system are equally deadly in their effects.

Another effect of transient overvoltages is related to equipment insulation. It has been realized only in recent years that many previously unexplained failures may have been due to breakdowns of insulation under high-voltage stresses which were not known to exist at the time; such voltages would ordinarily be lower in grounded systems. Many engineers do feel that equipment failures are fewer with the grounded system.

The grounded system can be relayed faster and more accurately. But it is likely to cost a bit more.

It may well be that the most significant factor in the grounded system controversy will be the widespread adoption of the 480Y/277-v combined power and lighting distribution system. This system calls for a wye-connected secondary; bringing out and grounding the neutral does not cost as much additional if it is first agreed to buy the wye-connected secondary for other purposes.

Outages and Costs

Undoubtedly, costs and service continuity are emerging as the most important factors in the selection of the industrial electrical distribution system. There was a time when plant engineers were happy to have all the lights on and all motors turning. There has been great progress beyond this stage. Power factor, regulation, investment cost, and other such factors are more fully appreciated today than ever before. With the swing toward automation and automatic materials handling, more tools will remain on longer—calling for even more, longer-sustained blocks of power in industry.

For modern systems, the major considerations being taken into account include flexibility, service continuity, regulation, efficiency, cost of operation and maintenance, and initial investment. The relative importance assigned to each of these factors determines ultimate choices for a particular plant.

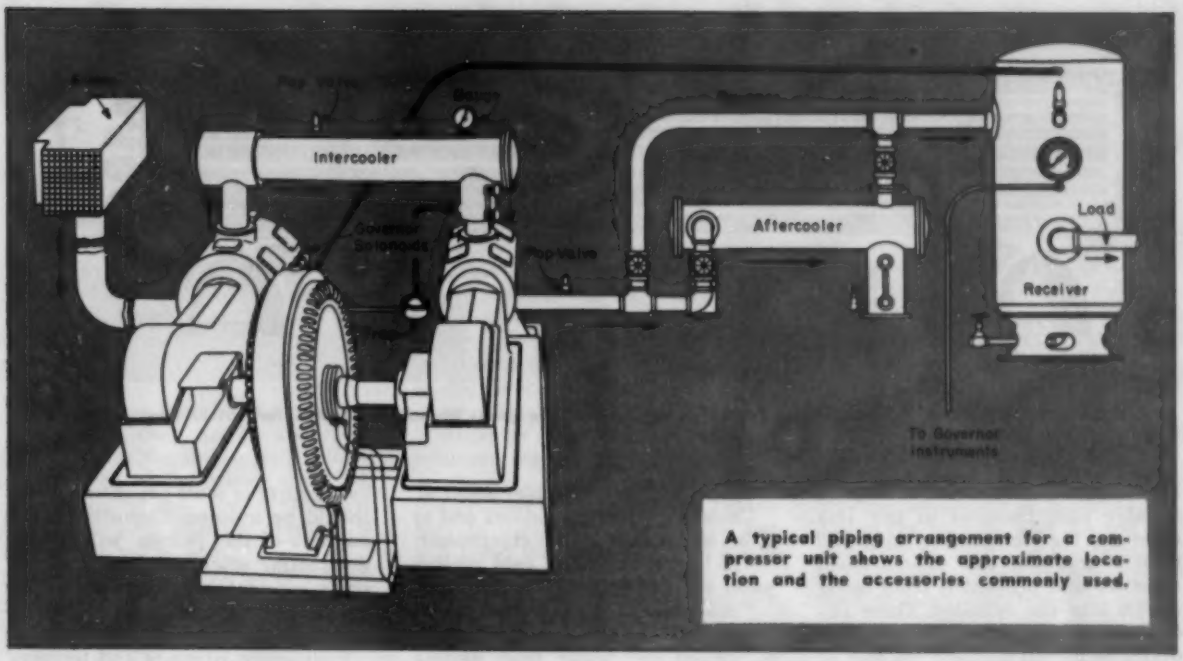
Throughout industry, increasingly expensive manpower and expensive machinery which are idled by an electrical outage make that outage increasingly expensive. The differential between the cost of an outage and the cost to prevent it is narrowing. There is more and more inclination to spend the money for systems and equipment to prevent and shorten outages.

The phenomenal increase in load densities reflects the increased importance of electrical service to the successful, profitable operation of any plant. The plant engineer would always do well to realize that the only power of any value is the power available and delivered.

CONSUMPTION OF ELECTRICITY IN 1953, BY INDUSTRIES

Chemicals	15 %
Steel	12 %
Non-ferrous and Miscellaneous Primary Metals	14 %
Petroleum and Natural Gas	7 %
Coal	2 %
Pulp and Paper	9 %
Textiles	5 %
Atomic Energy Commission	5 %
Rubber	2 %
Stone, Glass, and Clay	4 %
Miscellaneous (including Metalworking)	25 %
Total Industrial Consumption (253 billion kwh)	100 %

Westinghouse Electric Corporation



A typical piping arrangement for a compressor unit shows the approximate location and the accessories commonly used.

These Tips Will Prove Helpful When Installing and Maintaining

Air Compressors

H. W. WHITING
Worthington Corporation

WHEN A COMPRESSOR is located and properly mounted on a suitable foundation, the piping arrangement is the next consideration. Piping should be adequately supported with provisions made for thermal expansion and contraction. In laying out the piping it is important that any strains that might develop be directed away from the compressor connections.

All piping should be as direct and as short as possible. Long pipe bends or large radius elbows are used wherever turns are necessary. If possible, pockets where condensate or oil can collect are eliminated and the piping made self-draining.

To help in maintenance work, a color scheme can be adopted to identify the various piping services.

The one factor that is probably responsible for more trouble in the initial starting of a compressor unit than any other is unclean piping. Not enough emphasis has been placed upon the necessity for hammering and blowing out the pipes to insure that the suction lines are free from scale, welding shot, and dirt. If this material is allowed to get into a compressor cylinder, a maintenance problem of the first magnitude will result.

A clean, cool, dry air supply is essential to the satisfactory operation of a compressor. Wherever possible, the compressor intake should be piped to the outside air. The intake or suction piping must be thoroughly cleaned before installation and should terminate six feet or more above the ground or roof. It should also be located far enough from steam, gas, or oil engine exhaust pipes to insure air relatively free from dust, dirt, moisture, or contamination by exhaust gases. The open end of the intake pipe must be well hooded and screened to prevent foreign matter from entering.

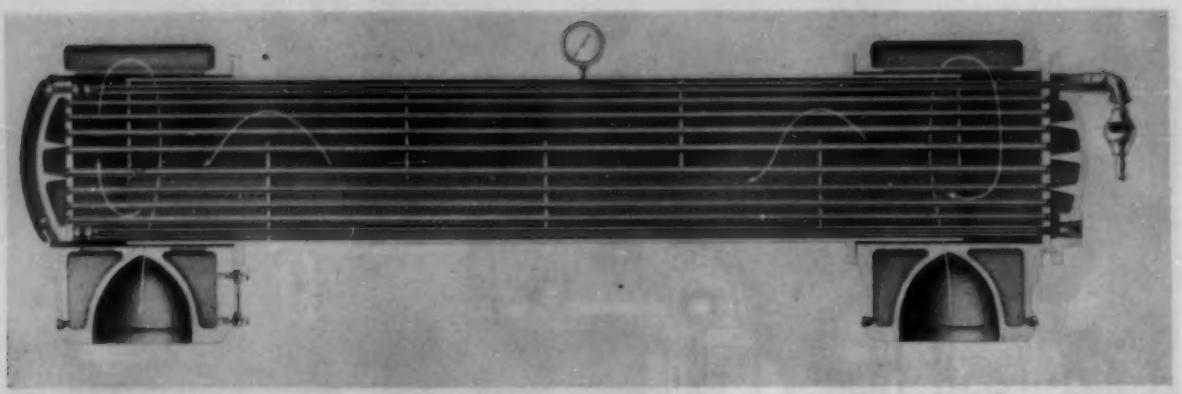
There are many good commercial air filters on the market. The installation of a proper size filter on an air intake line will more than compensate for itself in reduced maintenance on the compressor.

If the filter is located several feet away from the walls, it will minimize the pulsating effect on the walls and will be readily accessible for periodic servicing.

A concrete duct, built for use as an air intake, must have a smooth, hard, interior surface. If the concrete crumbles or disintegrates—as a result of the air rushing through—the ingredients are carried into the compressor cylinder and will cause rapid wear. Painting the interior of the concrete duct with a good waterproof paint is advisable.

If gas is used as the compressed medium, there will be high maintenance costs unless provisions are made to clean and dry the gas before it enters the compressor. Scrubbers, traps, or tanks of suitable size can be used to rid the gas of dirt and entrained moisture. Extreme care should be taken in arranging the suction or intake piping to avoid having loops or pockets in the line. Collected condensate can eventually be drawn into the compressor cylinder as a slug that will cause serious damage. Moisture and condensate will also bring about excessive wear of valves, cylinder linings, pistons, and rings.

The intake piping should drain toward the cylinder when wet vapors



A cross section through an inter-cooler indicates the flow of the gases around the baffles for better heat exchange.

are handled. Receivers or legs of suitable size, installed in the line close to the compressor cylinder, permit dropping out of entrained moisture and prevent it from being drawn into the cylinder. These receivers or legs are provided with drains to permit periodic removal of collected liquid. Long vertical lines leading directly to the cylinder are not recommended.

Care must be exercised to see that no leaks occur around pipe joints if suction pressures are below atmospheric. Air drawn into the cylinder will cause contamination of the gas, or perhaps form an explosive mixture, depending upon the nature of the gas. Special provisions must be made to pipe the release from unloading mechanism or pop valve back to the suction or intake line.

When a globe or gate valve is used in the discharge line between the compressor and receiver, a pop safety valve of sufficient size should be installed between this valve and the compressor. This will prevent any damage to the compressor in case the unit is started with the valve and by-pass closed. Set the safety valve to operate at five to ten pounds above the pressure which is to be carried in the discharge line, the exact setting depending on operating conditions. For gas service, a design is used that will pipe the exhaust wherever desired. A drain valve at the lowest point in the discharge line permits periodic draining of any accumulations that may form. A removable portion of the discharge pipe can be provided directly adjacent to the compressor so that this section can be readily removed, inspected, and cleaned of any carbon build-up when necessary.

The discharge piping must not be near wood or any other combustible materials. Gaskets in the discharge piping should be made of asbestos or oil-proof, noncombustible material.

Coolers are located indoors and as close as possible to the compressor.

¶ A liberal supply of cold cooling water must be supplied at all times.

¶ A separator on the discharge end is drained—preferably by a trap—to prevent any water from getting into the subsequent cylinder of an inter-cooler or in the lines feeding from the after-coolers.

Safety valves are located on the cold end of the cooler. This will prevent any possibility of the safety valve becoming inoperative through carbonization.

Receivers

Receivers are preferably placed outside in a cool shaded spot and located so that the entire unit can be easily painted or inspected. The receiver is piped so that the flow of air is through the receiver and continuously vents the oil vapors. A receiver should never be used as a surge chamber on the end of a line.

Before entering a receiver for an internal inspection, the interior must be thoroughly vented — there are cases on record where men have died from carbon-monoxide gas poisoning inside receivers.

The importance of providing a clean inlet line to the steam cylinders of a steam engine driven compressor as well as designing for proper drainage is again stressed. Regardless of whether the steam is saturated or super-heated, a separator must be provided in the inlet line as close to the steam cylinders as possible. A large steel receiver-type separator is preferred.

It is essential that full consideration be given not only to the quality and quantity of the cooling water for the unit, but to the temperature of the water as well—particularly when condensable gases or vapors are to be compressed in the unit. The use of dirty or scale depositing water should be avoided. Deposits on the surfaces of the jackets will reduce the cooling efficiency. It will necessitate considerable downtime of the unit to clean the jackets in order to maintain the over-all efficiency.

Frequently, pressure and temperature conditions of a condensable vapor or gas are such that when the gas contacts the cooler cylinder walls, condensation will take place. The resulting precipitation, in addition to destroying lubrication, can result in corrosion producing elements. In turn, this will cause excessive wear of the cylinder parts and result in high maintenance costs.

The only means of preventing condensation of the gas in the cylinder and valve ports is to make provisions in the jacket water piping system to supply water to the cylinders at a temperature somewhat higher (preferably 10 to 20 degrees) than the temperature of the incoming gas. This can be accomplished by using a source of warm water.

The quantity of water flow through the jackets can be regulated so that the outlet water temperature will not be more than 30 degrees above the inlet water temperature. An outlet water temperature of 160 F should not be exceeded. An adequate quantity of circulating water means reasonable velocities through the water passages, elimination at the air pockets that form "hot spots", and prevention of condensation of the gas in the cylinders.

Traps

Traps are placed in an accessible location, well below the drain point, and with the minimum lift for the trap discharge. Warm surroundings will minimize the possibility of the trap becoming inoperative as a result of congealed oil, and, if cold enough, possible freezing of the con-

densate. When the compressor is exposed to freezing temperatures, all water must be drained from the cylinders, inter-cooler, and after-cooler to prevent damage.

A by-pass around the trap will provide a check on the trap operation. Where several traps discharge into a common header, this header should be of an ample size so that it offers little restriction. It is also advisable to install check valves, preferably of the swing type, after each trap discharge line to prevent any back-flow from the header.

Valves

Gate valves, because of their lower pressure drop, are favored over globe valves for this service. However, when globe valves are used, the direction of flow of the gas should be such that the pressure is under the valve seat.

All valves should be located in an accessible location and tagged according to their service.

Safety valves should be set at approximately the maximum pressure rating of the vessel they are protecting. Under no circumstance are shut-off valves to be installed between safety valve and vessel.

To keep safety valves free, it is recommended that they be blown frequently.

The selection and use of the proper grade of oil for the compressor is important. Should the brand or type of oil ever be changed, it is a good idea to thoroughly flush out all the oil contacted cavities or the sludge that may have deposited in these places will become active because of the different chemical make-up of the new oil.

To avoid flashes or explosions, especially in air compressors, it is important to keep down the quantity of oil fed to the cylinders.

Check valves in the oil feed lines to the cylinders should be as close as possible to the point of application. This will prevent carbonization due to pressure changes in the check valves. For the same reason, the supply lines to the check valves should be spaced away from any hot parts of the cylinder or piping.

Where there is any possibility of moisture getting into the cylinders, or where condensation may form on the cylinder walls, it may be necessary to use a compounded oil that will resist the washing action of the moisture.

For those installations pumping a gas that has the tendency to thin the lubricant, a much heavier oil may be necessary. A compounded steam cylinder oil might be required.

For nonlubricated compressors, a periodic manual coating of the valve parts with glycerine will considerably improve their life.

Periodic Maintenance

A periodic inspection, repair, and cleaning of all valve parts will reduce maintenance costs. It is recommended that a complete set of spare valves be kept on hand so that the compressor downtime can be held to a minimum.

All unloaders, protective and overspeed devices should be inspected frequently.

Keeping a daily log of the temperatures and pressures will focus attention on any changes that might be taking place in the compressor unit—leaky valves, piston ring leakage, inadequate cooling water.

Bolts and nuts should be kept tight at all times—generally speaking, only a loose bolt fails in service. Where bolts and nuts have a tendency to loosen up in service, either the heads or nuts can be wired, or the bolt pricked with a center punch.

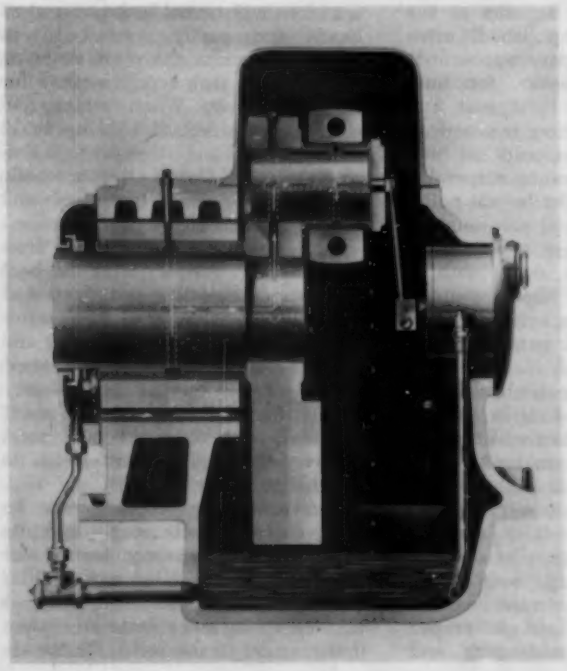
The packing should be removed when the unit is down for any considerable length of time. The difference in electrical potential between the packing and the rod can result in corrosion of the latter.

Flammable solvents are never used to clean compressor or piping.

Periodic inspections should be made at frequent intervals, with a complete static inspection every three years.

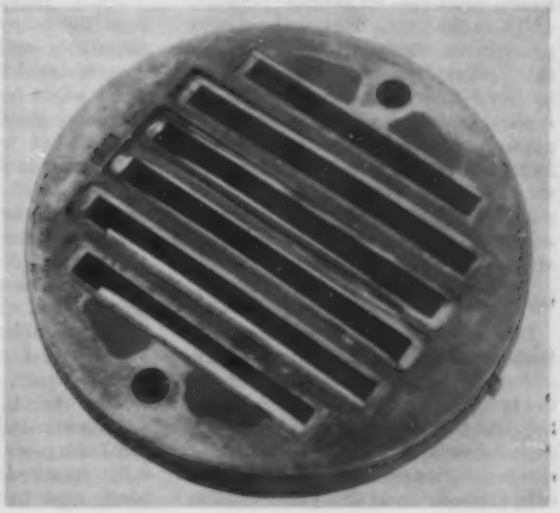
All defective parts, replacements, and other items of interest should be cataloged in a log book.

In connection with the internal inspection of any compressor, a responsible person must be certain that the line switch is open and tagged—in addition, the piston or running gear is blocked so that the unit cannot turn over while the unit is being inspected or serviced.



Good lubrication and flow of oil through the moving parts of the main bearing assembly is very important.

Corrosive effects of water or moisture on a valve seat will impair the compressor efficiency and operation.



Get Extra Life From Water Tanks

MOST INDUSTRIAL plants use elevated storage tanks to assure an adequate reserve water supply for fire protection, process requirements, and personal health. An elevated tank guarantees uninterrupted water service during the power outages, always provides a pressure boost to the distribution system, and permits pump operation at near rated head, thereby reducing power demand and energy costs. Such installations also can satisfy peak demands above daily pumpage.

In securing these advantages, industry spends more than $15 million yearly for necessary tank maintenance to provide an average tank life of 15 to 25 years. But with correct procedures, there is no reason why this period should not be three times as long. Every tank designed by a reputable company has a 40 to 50 percent structural overload safety factor. It has been built to withstand storms (even tornadoes), expansion and contraction during heat and cold, and the stress of emptying and refilling.

Internal Deterioration

Internal difficulties cause most tank deterioration. The inside of an average tank succumbs to rust about thirty times faster than the outside because the surfaces are alternately exposed to the atmosphere and submerged in water. This condition accelerates corrosion and promotes the formation of deposits. Ferric oxide, or iron rust, is the most common offender, and its removal further hastens the rate of attack on the metal underneath.

Since the average tank has ¼ inch of rust scale on the interior surfaces, periodic deposit removal is important. The most efficient method is the use of a mechanical scaler or chipping hammer. Sandblasting is not effective for heavy deposits as the rust scale becomes polished, often taking on the deceptive appearance of clean steel. However, for tank exteriors with only light rust and loose paint, sandblasting is practical.

Many tanks deteriorate at and near the bottom because suspended impurities settle to the lowest point. Accumulated mud and silt must be removed at least once a year. This cleaning should be done with a broom and water. Sharp pointed tools, such as shovels, hoes, and steel scrapers, will break paint coatings and expose the metal.

Temperature changes, pH changes, variations in dissolved solids content, and high flow velocities which cause erosion also complicate tank maintenance problems. All of these conditions tend to remove protective films because the metallic surfaces cannot absorb any type of coating.

Before painting, silt, mud, rust, and loose paint always must be carefully removed. Without a proper bond, new paint would crack and peel off. Interior surfaces then can be adequately protected with one of the asphalt base paints that are produced by major paint manufacturers. These materials are tasteless; nonpoisonous; resist chipping, cracking, and peeling; and dry completely within 24 hours. Asphalt base paints are not affected by water minerals and also protect the tank against electrolysis and lightning. Paints with linseed oil or varnish binders deteriorate rapidly, and the pigments drop off and leave the steel surfaces exposed.

Repairing Leaks

Cleaning and scaling tank interiors often will reveal leaks near rivet heads and partly wasted seams. Welding remains the most economical and best tank repair method for such conditions. When seams and rivets are welded, it adds up to 15 percent structural strength to a riveted tank. Welding a pit puts tensile strength back into the steel and guards against sheet deterioration.

Skip welding, however, is a dangerous repair procedure as the heat will expand the steel and rivets and may cause loosening of the seams when the metal cools. Caulking and patch bolts also weaken the tank. Where pits are in clusters or a section is wasted thin, the entire sheet should be cut out and new steel butt-welded in place. Butt-welds do not disfigure the tank.

Before welding all rust must be removed from rivets, seams, and pits with a chipping hammer. Seams and rivets should be filled with a fillet weld and again hammer chipped to remove slag and release any stress that may be in the weld. Rivets al-

ways should be welded first, and then the seams should be completely filled. A sponge, stringer, or tack weld is inefficient because it does not restore any structural strength.

If a tank bottom requires replacing and the remainder of the tank is in fair to good condition, the horizontal ring should be welded where the bottom and upper tank sections meet, tapering out to the vertical seams. If horizontal seams and rivets in the upper part of the tank are in bad condition, all horizontal seams and rivets should be welded, tapering out to vertical seams and rivets. However, it is not necessary to completely weld the entire tank when only part of it requires repair.

Sway rods should be checked and adjusted periodically. Variable tank loading and wind stresses tend to shear rivets, and tank collapse can result from unbalance on the supports. If seep leaks develop around rivet heads and seams and cause telltale streaks on the tank exterior, it should be interpreted as an advance warning of dangerous tank conditions. Partly or completely eaten away rivets and badly pitted sheets permit the caulking edge of seams to deteriorate, ultimately to the point of failure if neglected. When sheets separate under the weight of the water pushing out and down, unbalance on the supports could result in total collapse.

Cathodic Protection

Many plants now use cathodic protection to prevent rust, corrosion, and pitting. This method is based on the fundamental principle that when two dissimilar metals are immersed in an electrolytic solution and a direct current is passed through the cell thus formed, positively charged ions from the anode travel to the cathode, release their charge, and plate out on the cathode.

In practice, cathodic protection systems consist of an electric cell with properly located positive pole electrodes. The tank water serves as an electrolyte, while the tank itself is the negative pole. Low voltage direct current builds up a hydrogen film on tank surfaces, that minimizes oxygen contact with the steel. The system requires skillful design, especially in regard to the dissolved solids content of the water. Dissolved solids affect water conductivity as an electrolyte, and this in turn affects anode spacing and minimum voltage requirements. Anodes must be spaced to provide protective current to all parts of the tank.

Cathodic protection plus the cost of painting the inside tank roof, which the system cannot protect, is equal on a cost basis with two, 4-yr paintings. However, another advantage is that the tank does not have to be emptied for painting. Over 1600 tanks now have cathodic protection.

Annual Inspections

Tanks should be completely inspected at least yearly. The tank should be drained, the interior allowed to dry, and the paint closely checked. Paint defects, such as blisters, rust, and flaky spots, should be repaired to keep the paint film intact. These inspections and spot painting the interior will make complete repainting unnecessary for several years. Little steel will deteriorate and the tank should last indefinitely. Weekly visual ground inspections will show any telltale symptoms of leakage.

When draining a tank for inspection and repairs, the fire insurance companies must be notified. Failure to report tank outage can prejudice fire insurance policies. For safety, the tank should remain in the distribution circuit until it is three-fourths empty. Draining too close to bottom can result in debris clogging pump screens and causing pump damage. While the tank is empty, system pressure can be maintained by the plant water pumps. However, a pressure relief valve should be attached to one of the fire plugs in the system so excess pressure will automatically bleed off safely.

...but when their time is up

HERE IS ONE WAY to get a water tank cut down to size. This particular tank wrecking job was on a large standpipe once located in Erie, Pa. The job was to scrap the tank in the most practical and economical manner.

Overturning the structure and cutting it up while it lay on its side was considered, but the thought had to be discarded when it was noted that any way it fell it would do considerable damage. The standpipe was located in a residential district, and would have struck houses on two sides or would have fallen across a street in another direction. Falling away from the street, it would have sunk in the city reservoir.

Cutting it down, section by section, from the outside with workmen hanging from slings or scaffolds would have been one possible, but expensive and cumbersome, method.

A small genius on the contractor's crew came through with a solution. He suggested filling the tank with water, hoisting a rowboat over the top, and working from the boat.

The illustration shows the workmen completing the first cut from the top of the tank. As each section was cut away, the water level was lowered so that they could get to the section below.

Actually, scaffolding, as shown at right, was also used, but the boat helped in hanging the hooks after each cut.

This technique offers infinite possibilities. Think how an outboard motor would help on big tanks. On extended projects the tank could be stocked with trout so the workmen could fly cast during their lunch hour.

Operator adjusts the demineraliser. Only maintenance required is regeneration of the resins approximately once a week.

A Better Water at Lower Cost

IN THE CHEMICAL and pharmaceutical industries, it's axiomatic that the greater the degree of quality control, the higher are the production costs. Thus, it's very unusual when a plant has the ultimate in quality control and still saves money. One excellent example is the Bloomfield, N. J. installation of the Schering Corp. which produces ethical drugs—specifically, bulk and unit preparation of parenterals and ophthalmic and nasal solutions.

Quality Control

Two floors of the plant constitute the manufacturing section for parenterals. Operations include preparing the glass containers, compounding, filling, sealing, autoclaving, and inspection. The high standard of quality maintained throughout is best exemplified by the rigid control of the water that is used: (a) as process makeup water to produce the medicinals themselves; and (b) to wash the ampules, vials, and bottles in which the products are packaged. Ultraviolet sterilization is used to assure biologically pure water, and distillation and deionization are employed to assure chemically pure water.

Demineralization provides another very important advantage. By feeding only demineralized water to the still, troublesome still maintenance and attendant costly downtime are virtually eliminated. In fact, the still was taken down recently after a full year of operation and found to be exceptionally clean.

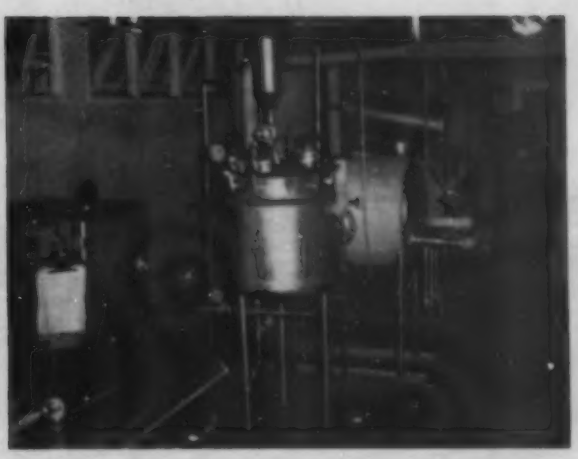
Operating Results

At present, the system has been operating satisfactorily for over two years, and there is no evident need for dismantling the still to clean the coils in the foreseeable future. Normally this job would have to be done once every six months or so in the Bloomfield area; as often as once a month in locations where the water is very hard and demands on stills are heavy. Also, plant personnel know that the still is always operating at maximum efficiency since there is no scale formation inside the tubes.

Water Treatment

Raw city water, containing 36 to 43 ppm hardness as $CaCO_3$ and the usual sedimentary impurities, comes into the plant at a rate of 60 to 90 gal per hr, although normal consumption averages 800 to 1000 gal per day. The initial treatment consists of two separate filtering operations in standard ceramic filters, and then the water enters a specially con-

Photo shows the ultraviolet irradiator which is used to sterilize all process water at the Schering plant.



Distilled water goes to a collection tank. If storage is required, the temperature is held between 80 & 90 C.

structed Elenite ultraviolet irradiator with two germicidal lamp banks.

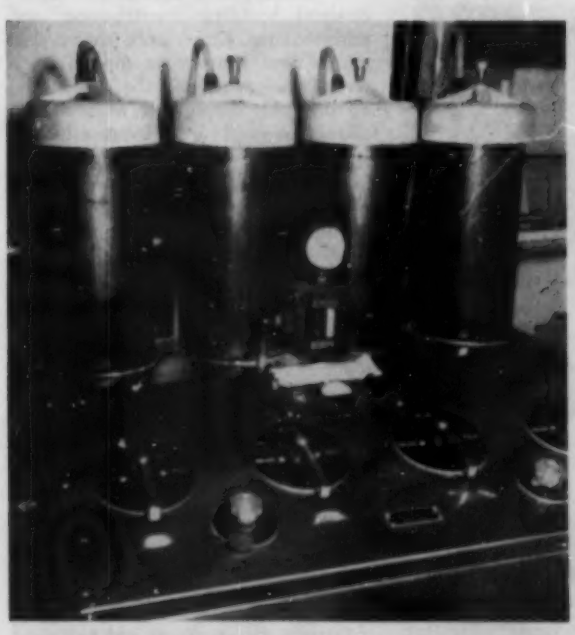
During this presterilization process, a stream of water flows through one of the tubes, killing and removing all bacteria so that none will get into the resin bed of the demineralizer. The water then goes into a Penfield U-60, two-bed demineralizer where it is deionized down to less than 5 ppm as $CaCO_3$. The only maintenance required is the regeneration of resins about once a week.

After demineralizing, the water returns to the ultraviolet sterilizer, this time passing through the second bank of lamps as a double check on biological purity. Finally, the water is filtered and diverted to a storage tank where the temperature is held between 80 and 90 C. This water is used for washing ampules, vials, bottles, and so forth.

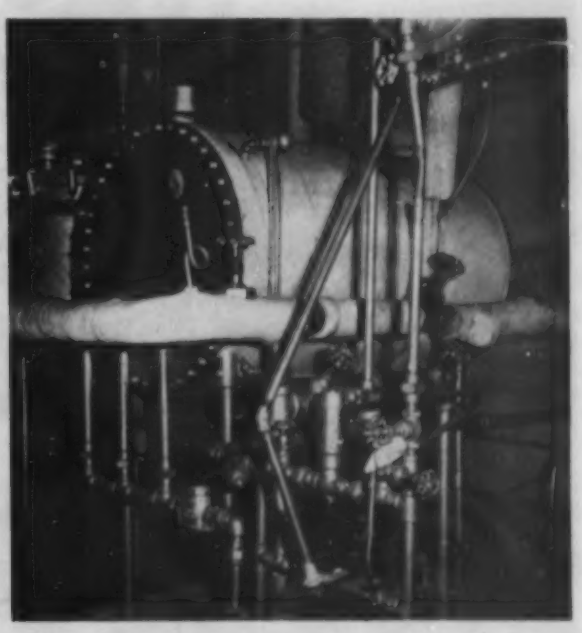
Distillation Facilities

Process water goes through exactly the same cycle except that after demineralizing, sterilizing, and filtering, the water also is distilled at a rate of 50 gal per hr in a standard distilling unit. After distillation, it flows to a collection tank, and if storage is necessary, the water is kept between 80 and 90 C. Actually, the water coming out of the demineralizer is pyrogen-free and able to meet USP standards. However, Schering, seeking the ultimate in safety, distills the water.

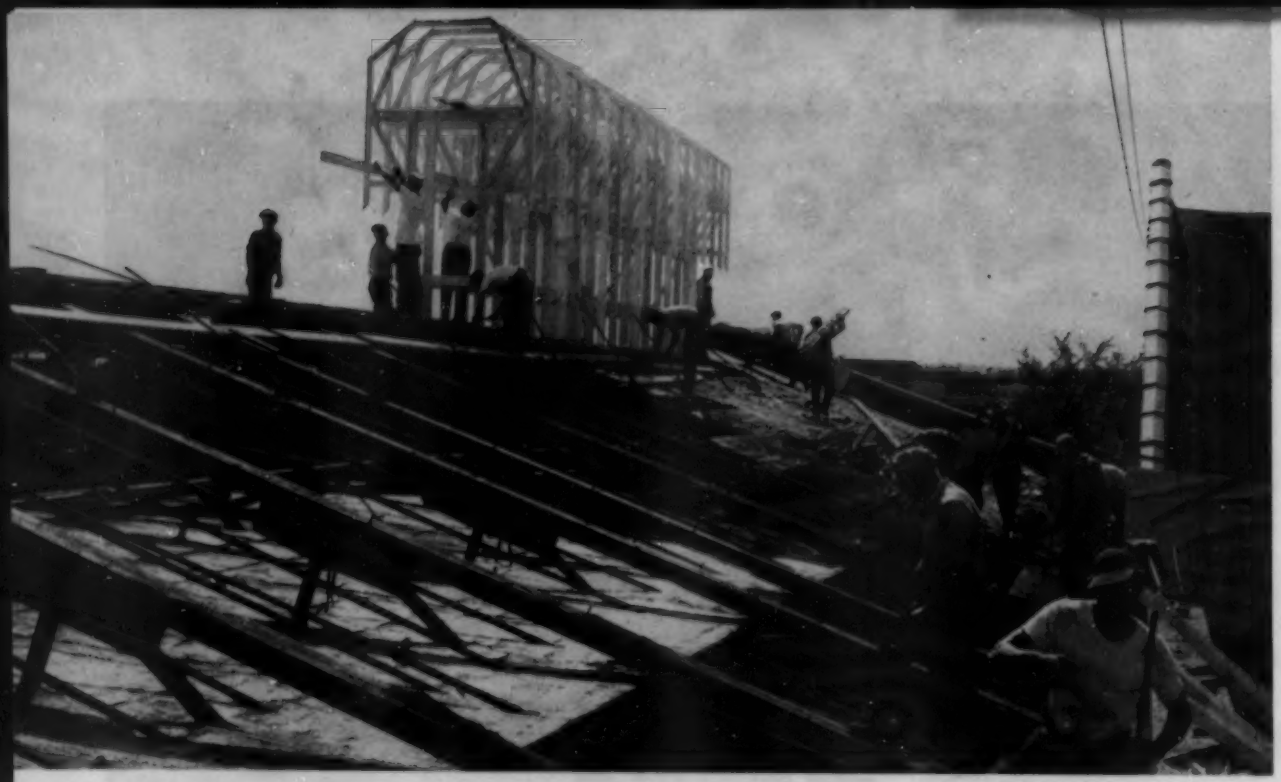
Aside from the investment in equipment, the costs for water treatment are negligible. The system provides chemically pure, pyrogen-free water, thus assuring the customer of getting the purest, safest product at the lowest possible cost. Continuous production is maintained with virtually no maintenance problem.



A Penfield U-60, two-bed demineralizer deionizes the raw water down to 5 ppm as $CaCO_3$ before distillation.



This standard Barnstead distilling unit processes 50 gal per hr. Only demineralized water enters the still.



It's an expensive maintenance item when wooden roofing and roof monitors have to be replaced every four to six years.

A Maintenance Headache Is Licked

Extreme temperatures and humidities helped cause this bad decay at the Sutherland Paper Co. plant.

WOOD PRESERVATIVES have found useful application in industrial building construction and maintenance. Experience shows that when new lumber is dipped in a wood preservative — the dip method probably being one of the simplest, cheapest, and most effective — it is more resistant to "dry rot" and decay, warping, checking, and termites, than if it had been left untreated. Using treated lumber in plant construction or repair reduces periodic maintenance and replacement of rotted pieces.

In Kalamazoo, Michigan, the Miller Lumber Co. (a local retail and wholesale lumber outlet) since 1938 has offered its customers facilities for treating their lumber. At a nominal cost of about 20 dollars per 1000 board feet, the wood is dipped for 3 minutes in a 22 ft by 6 ft tank. The 3 minute dip allows the preservative to penetrate approximately ⅛ in. into the vertical grain of the

wood with as much as 3 to 6 in. in the end grains. In applications where extreme temperatures or humidities exist, such as are found in paper mills, a longer dip time gives a correspondingly deeper penetration. Up to 3 hours is preferred. In general, the 3 minute dip suffices for wood used under ordinary conditions in roof deckings, sidings, window and door frames, exterior wood windows and doors. A pressure penetration treatment is available for applications where the surface of the wood is subject to severe wear — railroad ties for example.

Recommend Treatment

Treatment with a preservative is recommended for: 1) lumber that is exposed to extreme heat and humidity; 2) lumber that is sealed in construction and cannot be properly ventilated; 3) lumber that is green and may be subject to warping; 4) lumber that is used close to the ground and exposed to termites.

The basic ingredient of these wood preservatives is pentachlorophenol. This water-repellent chemical has proved its ability to withstand severe decay and insect attacks in field trials conducted by the Forest Products Laboratory, U. S. Department of Agriculture, as well as in tests conducted by the individual manufacturers.

Mr. H. J. Buttery, Maintenance Superintendent at the Sutherland Paper Co., in Kalamazoo, asked the help of some of the chemical manufacturers some years ago in overcoming the problem of recurring decay in the roof monitors of his plant. These monitors were originally built over the paper machines to carry away heat and water vapor through natural ventilation. The wooden construction was continually exposed to temperatures around 120 F with humidities close to 100 percent — ideal conditions for the type of fungi that produce wood decay. Despite the practice of priming every stick of kiln dried lumber used in deck and sidings with lead and oil, the lumber would be badly rotted within four to six years. It was then necessary to tear up the section of roof and the monitors and replace them with new wood — an expensive maintenance item.

As an initial attempt to reduce this maintenance, Mr. Buttery ordered several thousand board feet of lumber, dipped in a pentachlorophenol preservative for 3 hours, as decking lumber for one of the mills. The deck was built in the conventional way using asphalt, rag-felt paper, tar, and gravel. When the deck was opened up during some building alterations about six years later, the lumber was found to be sound and free of rot or decay. Since then, Buttery has used treated lumber almost exclusively throughout the plant buildings.

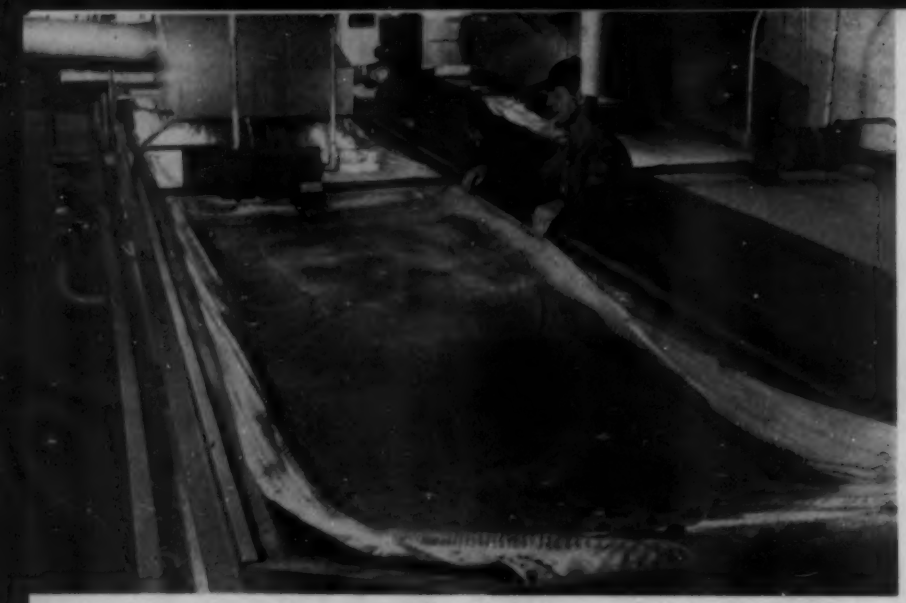
There are several advantages. Mr. Buttery estimates the total cost of treating the lumber is less than one percent of his building costs. In return, the life of the lumber is increased approximately 30 percent. During the war when kiln dried lumber was hard to obtain, it was found that green lumber, usually susceptible to warping, when treated with preservative, was quite satisfactory. Preservative treated wood was discovered to be particularly resistant to termites and has been used with success around all foundations and groundwork construction. The preservatives also tend to prevent checking in the lumber.

Disadvantage

According to Buttery, the one big disadvantage in using treated lumber is that it takes from 30 to 60 days for the preservative to thoroughly dry before the wood can be painted.

While most plants will not experience the extreme temperatures and humidities common at the Sutherland Paper Co., conditions conducive to rot may exist. If the life of this lumber can be increased, it may be possible to realize substantial savings in maintenance labor and materials. It may be sufficient justification for investigating the wood preservative treatment.

The new roof monitor on the right was built with treated lumber and after six years is still sound and free of rot or decay.

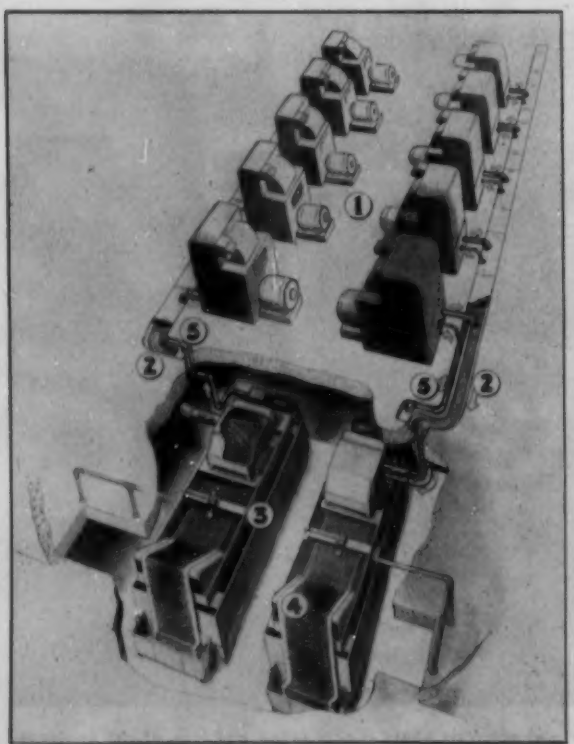


Spent coolant—returning from the grinders — discharges into filtering tanks where a continuous and slow travel of 48 in. wide filtering paper strains out and removes any contaminating particles.

New System Features Clean Coolant

A CENTRALIZED SYSTEM that collects, filters, and pumps liquid coolants in a closed circuit is especially applicable in plants using a series of machines that require a coolant in their operations. One of the few such systems in the country is that at the new Warner & Swasey plant at New Philadelphia, Ohio.

The coolant operation centers in a below-floor filtering and reservoir installation occupying an area 17 x 34 x 10 ft high. All of the plant's grinding machines are served by pressure piping from two 2100-gal-



No. 1 represents grinders; 2. coolant returns; 3. filter beds; 4. filter paper; and 5. clean coolant feed.

Pressure piping for fresh coolant and an open return trough for spent coolant occupy a common channel.

lon filtering tanks in this room. Spent coolant, containing work chips and abrasive particles, is discharged from the machines into a covered floor channel through which it flows back to the filtering tanks.

Spent coolant drops into either or both of the filtering tanks. Continuous roll feeds of 48 in. wide filtering paper strain the contaminating particles from the fluid. Clear coolant, withdrawn from the bottom of the tanks, is pumped back to the machines at a maximum relief valve setting of 25 psig.

Flexibility

The system is so interlocked that one or all of the three 450 gpm vaned impeller-type pumps may be operated in conjunction with one or both of the filtering tanks according to the number of machines operating. Twenty-eight grinders, varying in size from 4 x 18 in. external to 36 x 60 in. rotary surface units, are presently working in the system, which has an ultimate capacity of 40 machines operating from it.

Pumping rates and filter paper feed are regulated by level control switches in the tanks. Used filter paper feeds down into steel bins at the rear of the filter room. A fenced opening through the plant floor above permits periodical removal for disposal by the overhead bridge hoist serving the bay.

Advantages

This central coolant system offers a number of advantages. It eliminates grinder down-time and nonproductive labor required for the frequent sump cleaning ordinarily necessary on the individual machines if each were to rely on its own coolant system. It likewise insures a constant supply of clear coolant of an absolutely controlled mixture for better quality and finer finishes.

Coolant waste is virtually eliminated with centralized control. There is no throw-away involved because of mixtures becoming rancid in temporarily idle machines.

By supplying continuously filtered coolant to all the plant's grinding machines, this central coolant system substantially boosts efficiency and quality of grinding work.

Finally, the system makes it possible to consistently maintain a uniform coolant temperature. Based on saving the time of two men who would normally be needed for sump cleaning, plus the idle time of machines which would be required for the process, the entire installation is expected to pay for itself in two years or less.

Automatic Conveyors Facilitate Chip Handling

Chips discharge from some 40 machine tools to under-floor feeder conveyors. The system eliminates manual handling and saves 800 work-hours per day.

AN AUTOMATIC CONVEYOR system solves the classical machine-shop problem of chip handling at the recently expanded facilities of the U. S. Hoffman Machinery Corporation plant in Auburn, N. Y. The company estimates that this system saves more than 800 work-hours per day (three shifts).

Elements of the system, engineered and installed by the Gifford-Wood Company, Hudson, N. Y., include chip-handling feeder conveyors, main-line conveyor, chip crusher, pneumatic conveying system, and storage bins.

Machine tools are arranged so that chips (and coolant) discharge to under-floor feeder conveyors. At the present time, three feeder conveyors service some forty machines. The feeder conveyors carry the chips to a main-line conveyor.

Coolant collects in troughs beneath the conveyors and is piped to a flotation unit which reconditions it and pipes it back to the machines. This reconditioning process includes settling out of the heavy material and a foaming compartment which removes the fines from the coolant. The process also has the effect of aerating the coolant to keep it from becoming rancid.

The main-line conveyor carries chips to a crusher. After being broken into small pieces, the chips drop into one of the two discharge hoppers and through rotary feeders into airlines which convey them into the storage bins. These bins are installed alongside a railroad siding and discharge by gravity into hopper-bottom cars. The collected metal is sold as scrap.

The conveyors are of the hinged-pan type, the pans being 3/16 in. thick by 6 in. long by 30 in. wide. Pans are suspended from 1 in.-dia steel rods supported by two parallel endless roller chains. The 6 in.-pitch chains are guided in angle tracks that are fixed to the conveyor frame. Conveyors have 12-gauge steel skirt-plates for the full length of their run. The conveyor operates at a speed of 50-ft per minute and the crusher has a capacity of 5 tons per hour. Panel-mounted controls operate the feeder conveyors, main-line conveyor, crusher, rotary feeders, and air compressor.

Using Steel Strapping For Hanging Pipe

Acme Steel

Snubbing blocks permit even tensioning of steel bands.

WHEN LAYING pipe either inside or outside the plant, it is often necessary to cross under an existing pipeline. Supporting the existing line during excavation may present a major problem, especially if the line is large and cannot be removed from service and if the trench is to be relatively wide.

The Natt McDougall Co., Portland, Oregon, recently encountered such a problem on a large scale during the construction of a 60-in. concrete storm sewer. At one of the points of deepest cut, it was necessary to pass 20 feet below a water main consisting of 18-in. cast iron pipe resting in cradles inside a 48-in. protective concrete conduit made up in 4-ft lengths. Width of the trench would be about 50 feet at the surface, and the total weight of the water main which had to be supported was calculated to be 60,000 pounds.

Constructing a timber support on such a large scale would have been impractical, and several schemes such as an overhead cable suspension and stringer support beneath were considered. The method finally decided upon involved the use of ordinary steel strapping — the type used in shipping departments.

The concrete conduit was first exposed by removing all top dirt down to the center of the pipe. Four pile bents were then driven to form a 50-ft support consisting of a 30-ft center span and two 10-ft end spans. Each bent was made up of wood pilings, one on each side of the pipe, capped by a 12 x 12-in. timber straddling the top of the pipe. Beams, paralleling the water main, were then rested on the caps. Two, 18-in. I-beams were used for the center span, while two 6 x 12-in. timbers were used to span each end. Spacer blocks were employed to hold the timber beams apart, while the steel beams were placed side by side.

Bands of 1¼ x .035-in. steel strap were then slipped through the ground around the conduit and over the supporting beams. The bands were spaced 24 inches apart, two to each 4-ft length of conduit. Additional 2 x .050-in. bands were used where the cast iron main was supported on pipe cradles to insure against hidden concentrated loads.

To prevent free swinging of the conduit in the steel band slings, wood snubbing blocks were installed between the conduit and the overhead supporting beams. The bands were then tensioned and secured, thus completing an inexpensive, easily installed support.

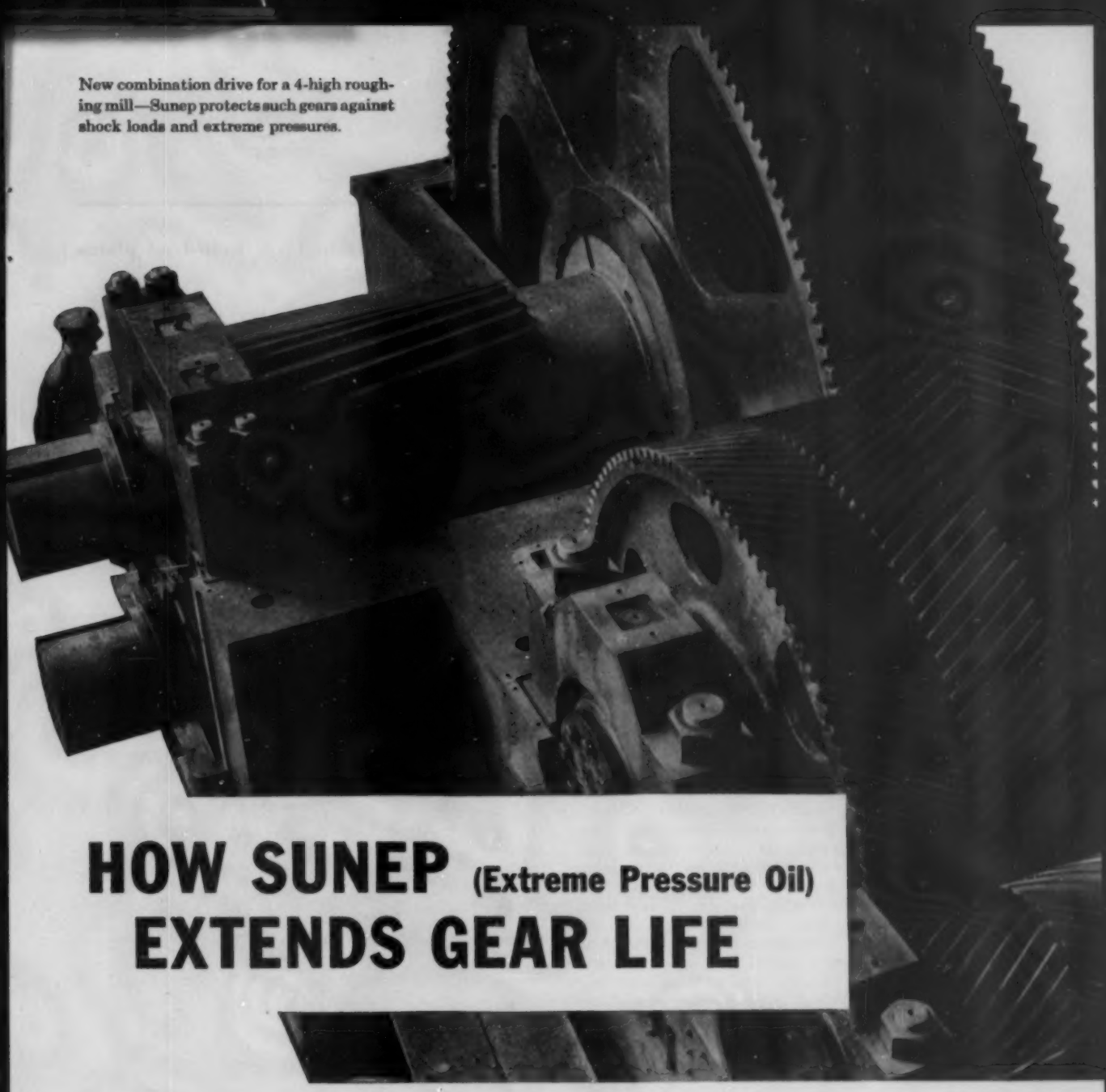
Excavation was then completed, the new pipe was placed, and backfill was made in the usual manner. The fact that the pipe was supported from above made it easy to insure complete and proper backfill support before relieving the temporary bridge of its load. When backfill was completed to the center of the pipe, the bands were easily cut and the supporting overhead structure was removed.

Acme Steel

Conduit, secured by steel band sling, is hung from two 30-ft I-beams, center, and two 10-ft timbers at each end.

Acme Steel

By hanging the water main from above, obstructions were avoided during construction work and backfilling.



New combination drive for a 4-high roughing mill—Sunep protects such gears against shock loads and extreme pressures.

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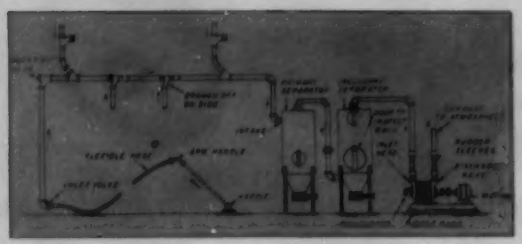
spot news

. . . what's happening in U. S. industrial plants



System Recovers Coal and Removes Fly-Ash Quickly and Economically

Well designed and conveniently located vacuum cleaning systems can do double duty, as demonstrated at the Clifton Paperboard Co. of Clifton, N. J.

The plant operates four large Harrington Stoker boilers (total 3300 hp) to produce steam used in manufacturing processes. During one week, over two tons of fine coal slip through the 21-ft-wide chain grates and collect in the wind box. Formerly, this coal was scraped out of the box and onto the boiler room floor to be shoveled into wheelbarrows and taken to the coal yard.

With the installation of a Lamson Billmyre central vacuum cleaning unit this process became cleaner and more convenient, with a saving of 60 percent in man-hours. During routine maintenance shut-downs, the vacuum system is used to clean out collected fly ash from the boilers. It has also proved valuable for clean-up of dirt and soot around the boiler room.

This is how the system works. Vacuum, created by a 790 cfm Lamson blower, is carried by piping to various locations in the boiler room. Hinged caps in the pipe enable workers to connect a flexible hose and nozzle assembly to the nearest vacuum outlet. Separators installed on the vacuum side of the exhauster collect the coal. Larger particles are then dropped into a wheeled lorry which takes the coal back to the furnace hopper. Fine particles and dust are reclaimed by a vacuum driven fly-ash reclaimer connected to the secondary separator.

Chief engineer at the Paperboard Company, Joseph H. Kroboth, estimates that the system paid for itself fully in about two years.

Yankee Ingenuity Started Company 75 Years Ago

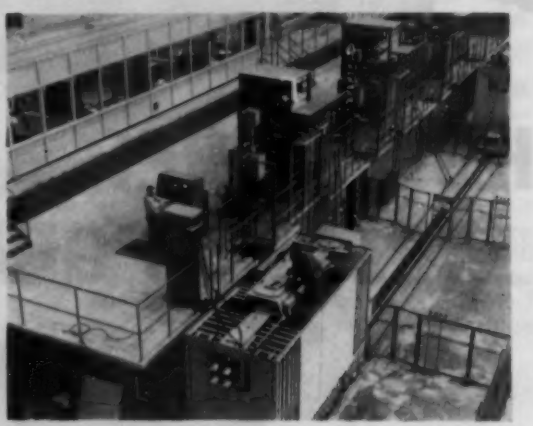
Founded by an ingenious Yankee, L. J. Wing, whose pioneering work is said to be responsible for much of the present day development in the heating and ventilating fields, L. J. Wing Manufacturing Co. is celebrating its 75th year in business.

Mr. Wing's work in the early days centered around the development and construction of propeller type disc fans which were used for ventilation and drying. These were driven in several ways, first by pulleys from line shafting, and, as development progressed, by individual steam engines, first by belt and later by direct connection and also by gas engines and by electric motors, most of which were largely designed and manufactured completely by the Wing Company in its own shops.

The individual steam turbine-driven fan introduced by the company in 1905 to furnish forced draft for boiler furnaces supplanted the old steam jet blower and later largely supplanted the centrifugal type blower. Previously most installations consisted of a single system for all boilers.

The lightweight, overhead-suspended and downward discharge unit heater, which today probably constitutes the basic design of the majority of all currently constructed industrial heating applications, invented by H. S. Wheller, now president of the company, was introduced in 1920.

Present officers of the company are: Harry S. Wheller, president and general manager; Walter W. Wilson, vice president and treasurer; and Charles H. Smith, vice president and secretary.



Power-Transformer Mass Production Realized at New Plant

With nearly a half mile of conveyors, new processes, and new machinery at the new Rome, Ga. plant, General Electric Co. has succeeded in reducing by more than 1/3 the manufacturing cycle for medium size transformers.

The mechanization at the new plant is a radical departure from the job-shop methods employed in the past in making such large units. (Transformers rated 501 kva to 10,000 kva, 69,000 v and below will be produced). Sizes will be intermixed in production lines and special equipment has been designed for handling the variety of sizes.

Three types of conveyors are used: dragline, moving sidewalk, and elevated slat conveyors. At the end of line, completed transformers are transported through 12

test berths on conveyors (see illustration). To further facilitate handling in the plant buildings, there are 15 large cranes, 10 tons capacity and up, and 40 smaller cranes from 1 to 5 tons capacity.

Time and Materials Saved With New Splicing Method

Using a new system of wire rope pressing that eliminates hand splicing, one worker can make as many as 20 to 30 splices an hour, compared to the six or seven possible using hand methods.

The system, developed by Jones & Laughlin Steel Corp., employs an aluminum alloy clamp or sleeve that is squeezed around the wire rope in a special 300-ton hydraulic press. Called JalKlamp, the device is used as a mechanical method of splicing eyes, with or without thimbles, in the ends of wire rope. This "splice" is said to give 100 percent of the breaking strength of the wire rope itself and saves about 85 percent of the length necessary for a hand splice.

Jones & Laughlin leases the special presses and complete sets of dies for different rope diameters.

Engineering Service Offers Advice on Fastening Problems

Thread Engineering Advisory Service, organized to make available the specialized know-how of a staff of fastening engineers, offers free advice on problems with screw thread fastenings such as:

¶ Tapped thread strength in brittle or light metals, plastics, or woods;

¶ Frictional wear on threads subject to frequent disassembly;

¶ Vibration wear on threads subject to extreme oscillation;

¶ Corrosion resistance of threads subject to high humidity or reactive atmospheres;

¶ Deterioration caused by high temperatures.

An analysis of the problem, including controlled tests, will be made, when necessary, in the Research and Development Laboratory of the Heli-Coil Corp., the company offering this service. More information is available from Heli-Coil at 1502 Shelter Rock Lane, Danbury, Conn. Also see INDUSTRY AND POWER, May, 1954, "Maintenance Applications for Wire Thread Inserts."

(Continued on page 116)

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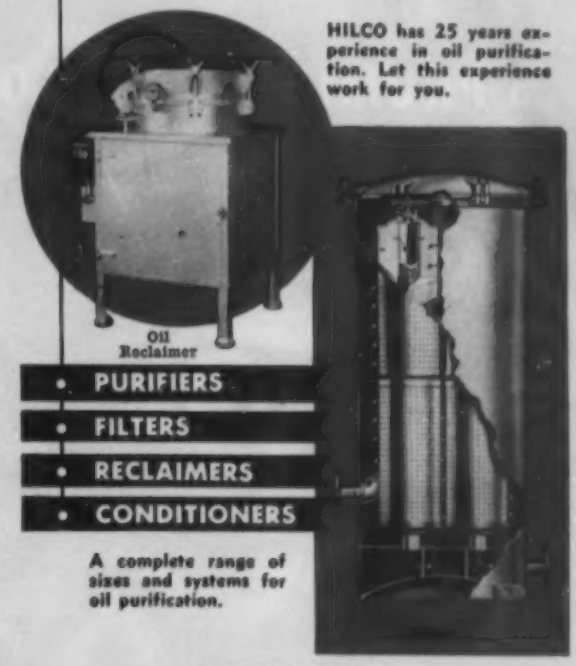

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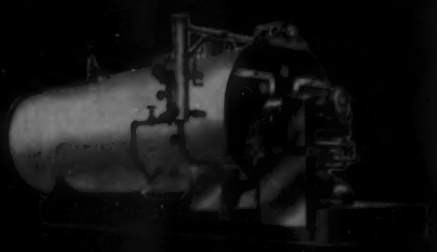
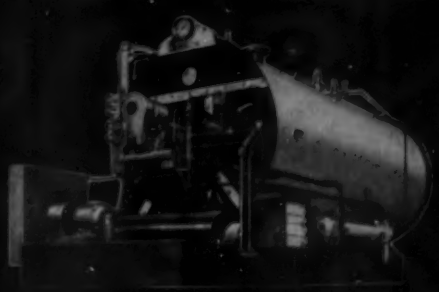
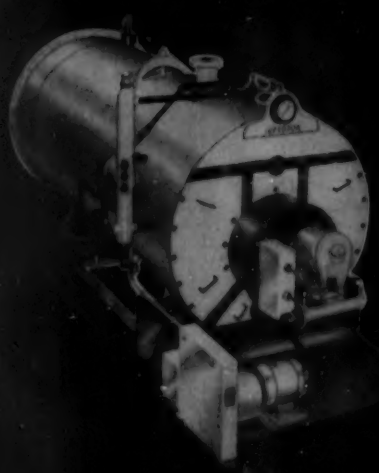




Behind these steam lines

a PROMISE of PERFORMANCE



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readers' guide

. . . an index to advertised products

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names make news

. . . personalities from industry and power

Riley Stoker Corp. announces appointment of **Robert J. Krieger** as vice president-sales.

Krieger **Connor**

The Babcock & Wilcox Co. pres., **Alfred Iddles,** has received the honorary degree of Doctor of Engineering from Michigan State College. He has also accepted chairmanship of the Industrial Equipment Div. for this year's National Safety Council campaign.

N. J. Connor becomes manager of the New York district office, replacing **H. E. Martin,** who has resigned to become president and a director of Metal & Thermit Corp.

Universal Atlas Cement Co.—Albert O. Stark vp sales, eastern and southern region, is retiring after 48 years with the company. Elected to succeed Stark is **Fred L. Wagner. Louis V. Walsh** becomes sales manager of the company's Pittsburgh territory.

Allis-Chalmers Mfg. Co., General Machinery Div. announces appointment of **R. C. Allen** as director of mechanical engineering, and **L. J. Linde** as director of electrical engineering. In the power department of the division **William M. Wallace** becomes assistant manager.

At the West Allis Works, **Lloyd M. Dings, Jr.** is appointed supt. of utility services. **Peter J. Engel** is appointed assistant supt. and **Russel Milbrath** is general foreman of the steam fitting department.

In the steam turbine section **H. D. Emmert** is engineer-in-charge of development.

Fred W. Bush is assistant to the vp in charge of transformer and switch gear equipment, and [illegible] becomes general [illegible] burgh Works.

Westinghouse El[illegible] ly elected vp's are [illegible] ham, Dale McFeat[illegible] Rae. E. V. Huggin[illegible] affairs, is also nam[illegible] company to succeed [illegible] who retires after s[illegible] since 1937.

Donald C. Burnh[illegible] pany as vp in charge [illegible] He succeeds **T. I.** [illegible] retiring.

For inventing a [illegible] excessive current du[illegible] other causes, **Ralph** [illegible] eran engineer of the [illegible] a Westinghouse $500[illegible] vention" award.

Standard Pressed S[illegible] **Edward H. Wheeler** [illegible] Forging Div. Succee[illegible] engineer is **John M.**

The National Su[illegible] **W. McKinney** is el[illegible] succeed **Alexander E** [illegible] is re-elected chairma[illegible] chief executive office[illegible] **William P. Stree[illegible]** manager of the New[illegible] of the Engine Div. [illegible] **Harry Nilsson,** who[illegible]

D. J. Murray Mfg.[illegible] **A. W. Plier** presi[illegible] manager. Other [illegible] **M. P. McCullough** a[illegible] vice presidents; **W. [illegible] Marquardt,** secretary; **G. L. Ruder,** treasurer; **P. W. Hoeper,** assistant secretary; and **Fred C. Boyce,** assistant treasurer.

I-T-E Circuit Breaker Co. announces that, through an exchange of common stock, BullDog Electric Products Co. has become a subsidiary of I-T-E. **William H. Frank** remains as president of BullDog and he and **Henry B. Frank** will join the Board of [illegible]

WAV
PAG

K. K. Grobholz becomes manager of Reciprocating Pump Sales Section at Oil City.

General manager of the reorganized Vertical Turbine Pump Div. is **Fenmore E. Dunn.**

American Society of Mechanical Engineers has elevated to the grade Fellow, **Willard F. Rockwell,** Rockwell Mfg. Co. and **Ernest G. De Coriolis,** Surface Combustion Corp.

Nominees for offices in ASME for 1955 are: president—**David W. R. Morgan,** Westinghouse Electric Co.; vice presidents—**James B. Jones** of Virginia Polytechnic Institute, **Ben G. Elliott** of the University of Wisconsin, **C. H. Shumaker** of Southern Methodist University, and **William H. Byrne** of Byrne Associates, Inc. and Stevens and Wood, Inc. Nominated as directors-at-large are: **Louis F. Polk,** Sheffield Corp., Dayton; **George A. Hawkins,** Purdue University; and **Harold C. R. Carlson,** The Carlson Co., New York.

HONORARY DOCTOR OF ENGINEERING

Pres. Harry S. Rogers of Brooklyn Polytechnic Institute presents honorary Doctor of Engineering degree to Martens H. Isenberg, right, pres. and director of Combustion Engineering Inc., while Preston R. Bassett, pres. of Sperry-Gyroscope Corp. and Brooklyn Polytechnic Institute looks on.

TERRY

AVY

GES

The Terry Solid-wheel Turbine is of the impulse, helical flow type. The steam issues from an expanding nozzle at high velocity and enters the wheel bucket where its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is returned to the wheel several times until practically all of the energy has been utilized. This principle makes possible the efficient use of steam in a single-piece, almost indestructible wheel.

The blades cannot foul. There is a one inch clearance on either side of the wheel. In addition, projecting rims on each side of the buckets prevent damage to the blades even though external thrust should move the wheel.

This is only one of the many important features of the Terry Solid-wheel Turbine. Write for complete details.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1195

Memo

Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.

Circle 538 on Reply Card for more data

names make news

. . . personalities from industry and power

Riley Stoker Corp. announces appointment of **Robert J. Krieger** as vice president-sales.

Krieger **Connor**

The Babcock & Wilcox Co. pres., **Alfred Iddles,** has received the honorary degree of Doctor of Engineering from Michigan State College. He has also accepted chairmanship of the Industrial Equipment Div. for this year's National Safety Council campaign.

N. J. Connor becomes manager of the New York district office, replacing **H. E. Martin,** who has resigned to become president and a director of Metal & Thermit Corp.

Universal Atlas Cement Co.—Albert O. Stark vp sales, eastern and southern region, is retiring after 48 years with the company. Elected to succeed Stark is **Fred L. Wagner. Louis V. Walsh** becomes sales manager of the company's Pittsburgh territory.

Allis-Chalmers Mfg. Co., General Machinery Div. announces appointment of **R. C. Allen** as director of mechanical engineering, and **L. J. Linde** as director of electrical engineering. In the power department of the division **William M. Wallace** becomes assistant manager.

At the West Allis Works, **Lloyd M. Dings, Jr.** is appointed supt. of utility services. **Peter J. Engel** is appointed assistant supt. and **Russel Milbrath** is general foreman of the steam fitting department.

In the steam turbine section **H. D. Emmert** is engineer-in-charge of development.

Fred W. Bush is assistant to the vp in charge of transformer and switch gear equipment, and **David A. Griffith** becomes general manager of the Pittsburgh Works.

Westinghouse Electric Corp.—Newly elected vp's are: **Walter J. Maytham, Dale McFeatters,** and **Otis O. Rae. E. V. Huggins** vp of corporate affairs, is also named secretary of the company to succeed **C. W. Pomeroy,** who retires after serving as secretary since 1937.

Donald C. Burnham joins the company as vp in charge of manufacturing. He succeeds **T. I. Phillips,** who is retiring.

For inventing a way to "detour" excessive current due to lightning or other causes, **Ralph E. Marbury,** veteran engineer of the company, receives a Westinghouse $5000 "outstanding invention" award.

Standard Pressed Steel Co. has made **Edward H. Wheeler** manager of the Forging Div. Succeeding him as chief engineer is **John M. Sherman.**

The National Supply Co.—Arthur W. McKinney is elected president to succeed **Alexander E. Walker.** Walker is re-elected chairman of the board and chief executive officer of the company. **William P. Streeter** is appointed manager of the New York City office of the Engine Div. He succeeds **Kjell Harry Nilsson,** who has retired.

D. J. Murray Mfg. Co. has re-elected **A. W. Plier** president and general manager. Other officers elected are: **M. P. McCullough** and **D. C. Everest,** vice presidents; **W. P. Marquardt,** secretary; **G. L. Ruder,** treasurer; **P. W. Hoeper,** assistant secretary; and **Fred C. Boyce,** assistant treasurer.

I-T-E Circuit Breaker Co. announces that, through an exchange of common stock, BullDog Electric Products Co. has become a subsidiary of I-T-E. **William H. Frank** remains as president of BullDog and he and **Henry B. Frank** will join the Board of Directors of I-T-E. BullDog will continue to operate under its own corporate name with the same personnel.

International Nickel Co., Inc.—Frank L. LaQue is elected vice president and manager of the Development and Research Div. **Thomas H. Wickenden,** whom he succeeds, will continue to serve the company as a consultant on special projects. **O. B. J. Fraser** and **Donald J. Reese** will serve as assistant managers of the Division.

Bell & Gossett Co.—Ralph A. Patterson has been moved up to vice president and will be transferred to New York City to establish a new office. He will also be responsible for all of New England, eastern New York State, New Jersey, eastern Pennsylvania, and Delaware.

Patterson **Theilig**

Worthington Corp.—In the power pump section, **E. W. Theilig** becomes chief engineer of the Power Pump Engineering Dept. with headquarters at the Oil City Works.

R. K. Grobholz becomes manager of Reciprocating Pump Sales Section at Oil City.

General manager of the reorganized Vertical Turbine Pump Div. is **Fenmore E. Dunn.**

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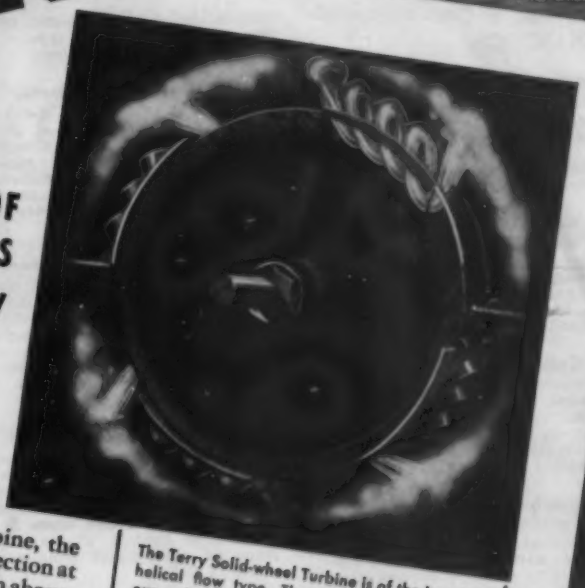
TERRY

PROTECTION OF TURBINE BLADES made possible by nozzle location



The Terry Solid-wheel Turbine is of the impulse, helical flow type. The steam issues from an expanding nozzle at high velocity and enters the wheel bucket where its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is returned to the wheel several times until practically all of the energy has been utilized. This principle makes possible the efficient use of steam in a single-piece, almost indestructible wheel.

In the Terry Solid-wheel Turbine, the steam enters the buckets in a direction at right angles to the shaft, as shown above. This design eliminates the need for close clearances and provides positive blade protection.

The blades cannot foul. There is a one inch clearance on either side of the wheel. In addition, projecting rims on each side of the buckets prevent damage to the blades even though external thrust should move the wheel.

This is only one of the many important features of the Terry Solid-wheel Turbine. Write for complete details.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1195

Memo

Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.

Circle 538 on Reply Card for more data

bulletins

. . . for listing of the bulletins just received see page 38

AIR CLEANING & DUST COLLECTION

250—Small Scale Dehydration

To meet the increased demand in engineering operations for small volumes of dry gases not warranting plant size installation, this company has developed the Hydryer, described in seven-page booklet. J. F. Pritchard & Co., Equipment Div.

251—Dust Collectors and Arresters

Series of four folders describes cyclone type collector and portable, standard, and automatic bag-type dust arrestors. Also includes 32-page catalog describing exhaust fans for dust collecting and air handling. Northern Blower Co.

252—Dust Collectors

Dust collectors, including cyclone, wet or dry dynamic, and cloth screen arrestor types are the subject of a 32-page bulletin. Uses of air conditioning, ventilating, conveying, drying, and cooling units are presented. Kirk & Blum Mfg. Co.

253—Precipitation Equipment

Engineers contemplating the installation of equipment for recovering dusts, fly ash, fumes, mists, fogs, or other similar suspensions in stack or process gases will find much valuable data in this 40 page booklet. Western Precipitation Corp.

254—Industrial Dusts

"The Collection and Recovery of Industrial Dusts," 32-page manual 101, discusses various types of dust and techniques used in analysis, lists the factors which influence choice of equipment, and explains the operation of each type of collector. Buell Engineering Co., Inc.

255—Electrical Precipitators

Booklet 2-ATC covers the history and fundamentals of electrical precipitators, design and construction, dimensions and capacities, electronic power supply, selenium power supply, and installation stories. Provides an up-to-date discussion with illustrations of latest developments. The Aerotec Corp.

256—Tubular Dust Collectors

Booklets 2-PDC and 3-PDC on mechanical dust collectors covers capacities and efficiencies, dimensions, construction and the decantation method. Latter method is used on installations where re-injection of large, unburned high carbon particles is required for economical operation. Pratt-Daniel Corp.

257—Industrial Dusts

Booklet 3-TTC gives a brief background of modern dust problems and an approach to their solution. Discussed are sources of dust, determining dust size, prediction, fly-ash emission codes, types of dust and methods of control. Diagram shows distance of dust travel from source. The Thermix Corp.

240—Dust and Fume Removal

This 19-page bulletin, 610, pictures and describes the standard units that go to make up the Multi-Wash System for the removal of air-borne dust, fumes, vapors, and odors. Besides explaining the operation and advantages of each component of the system, the booklet includes many installation photographs. Claude B. Schneible Co.

AIR CONDITIONING — HEATING & REFRIGERATION

258—Temperature, Moisture Control

Precision control of air temperature and moisture enable you to produce your production in any climate, at any season, according to six-page bulletin 122. The Type "A" air conditioner described, for drying or moistening of air, is shown in typical installation photographs. Niagara Blower Co.

259—Propeller Fans

Three new models are among the 13 types of fans shown in 40-page bulletin A-109. It also describes three types of roof ventilators, unit heaters and intake air units, and includes specifications, dimensions, and performance figures on all of the equipment plus valuable engineering data. Hartzell Propeller Fan Co.

260—Woven Electric Heaters

Pre-Fab woven electric heaters are described in folder 1548 which illustrates typical uses and gives application data for this versatile heat source. Suggested uses such as for heating gearboxes, local comfort heating, and for preventing condensation are listed along with application data. Pre-Fab Heater Co., Subsidiary of Edwin L. Wiegand Co.

261—Unit Heaters

Catalog CUH 846-A gives the complete story on Grid unit heaters. Catalog BC-1040 describes Grid blast coils for process drying. How the construction of the unit heaters prevents electrolytic corrosion is explained in booklet "Corrosion in Unit Heaters." Three useful reference books. D. J. Murray Manufacturing Co.

BOILERS & STEAM

262—Vertical Unit Boiler

More than 25 years of development, manufacturing, and application experience are reflected in the design of the Type VU-10 vertical-unit boiler described in 16-page bulletin VU 10-8. Advantages and design features are discussed. Various possible installations are shown. Combustion Engineering, Inc.

263—Feedwater Gas Analyzer

Described in four-page folder 148BP is an analyzer for measuring dissolved oxygen and hydrogen in feedwater. Advantages, ranges, and accuracy are discussed. Cambridge Instrument Co., Inc.

264—Refuse and Wood Burning

Engineering data concerning spreader stokers installed to burn refuse or wood are contained in 24-page booklet 505. Stationary, manual dumping, power dumping, and traveling grate installations having maximum capacities from 10,000 to 275,000 lb steam per hr, steam or compressed air operated, are described. Detroit Stoker Co.

265—Boiler Controls

Specifications for the fully automatic, all electric metering type packaged control for shop assembled boilers are given in four-page folder 53-1088-230. Schematic drawing shows a typical packaged control system for a combination oil or gas fired boiler. The Hays Corp.

266—Simplified Boilers

The new line of simplified Powermaster packaged automatic boilers in sizes 15 through 100 hp, light oil or gas, are discussed in eight-page bulletin 1230. Details of design and construction, a cutaway view, and sample specifications are given. Orr & Sembower, Inc.

267—Pressure Equipment

One of the country's oldest manufacturers of equipment and accessories for plants piping steam, air, and gas under pressure, has published catalog 400, covering its line of separators, traps, and boiler trim. A condensation of the information in catalogs 500, 600, and 700, the booklet gives size and pressure tables and technical data. Wright-Austin Co.

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NOTE—Each bulletin item has a key number for your convenience in asking for a free, personal copy. Circle key numbers on Reply Card between page 34/35 & 90/91.

NO Reducing Valve Needed

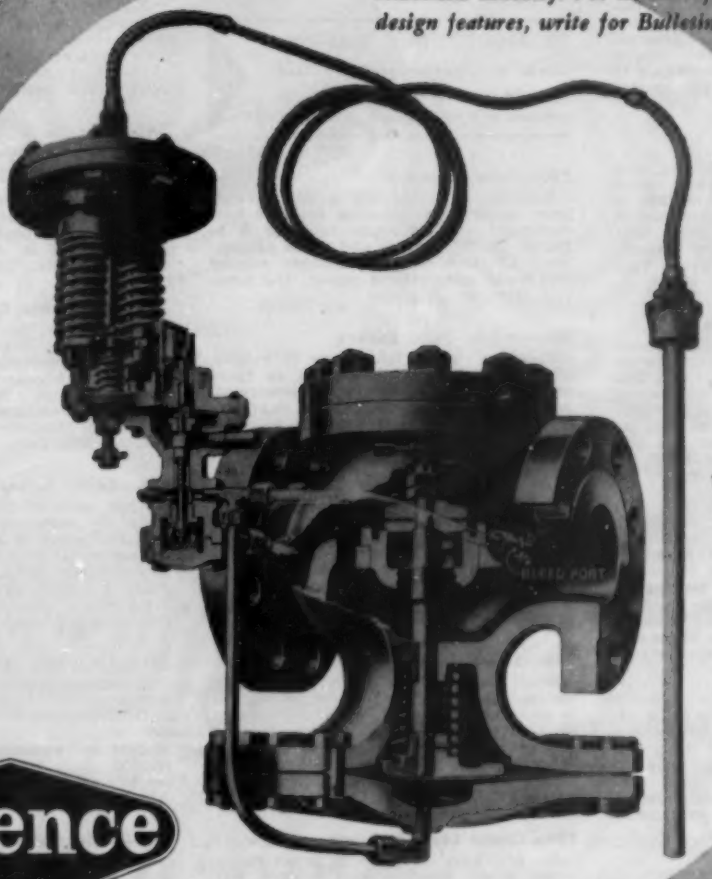
Here's real economy in temperature control.

Because Spence Temperature Regulators are designed to limit heater steam pressures to an adjustable maximum, the need for a separate reducing valve is completely eliminated.

The Spence Regulator takes steam directly from the boiler or high pressure line, reduces the pressure and regulates the flow as required to maintain a constant temperature output from the heater.

This means one relatively small combination pressure and temperature regulator replaces a reducing valve of the same size and a larger temperature regulator. Practically the entire cost of the large separate temperature regulator is saved. And, the total saving would also include the cost of a 3-valve by-pass along with all labor for installation.

This design feature is just one of the reasons for the thousands of Spence installations throughout American industry. *For details of other important design features, write for Bulletin T50.*



SPENCE
TYPE ET150
Temperature
Regulator

Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

Circle 539 on Reply Card for more data

bulletins

—Starts on page 94

268—Firing Equipment

Over 50 years of leadership in the manufacture of industrial-commercial firing equipment is reflected in 19-page general catalog 3048. Schematic drawings, layouts of typical installations, cutaway views of burners and burner parts, and photographs of burners and installations are included. Petro Division.

269—Cyclonic Combustion

Principles of the patented method of Cyclonic Combustion are explained in four-page folder, "All Your Questions Are Answered by Cyclotherm." Descriptive drawings show how air is introduced into the combustion chamber at extremely high speeds in a revolving spiral vortex, radiating heat to the fire tube through direct radiation and convection. Cyclotherm Division of United States Radiator Corp.

270—Boiler Replacement

"What Every Business Man Should Know About Boilers," has been prepared to give executives a better understanding of boilers and a realization of the tremendous loss that industry is taking due to obsolete and inefficient steam generating equipment. Chances are two to one that your boiler is obsolete, according to this 14-page booklet. Superior Combustion Industries, Inc.

271—General Catalog

A wealth of research, engineering, and manufacturing experience, gained since the founding of this company in 1880, is incorporated in the products described in four-page folder. Steam generators, heat transfer equipment, pressure vessels, valves, and fittings are shown. Henry Vogt Machine Co.

272—Coal-Burning Installation

"Burning Bituminous Coal the Modern Way," contains 24 pages of case histories from industries of all sizes and types. Engineering survey results for equipment such as boilers, stokers, coal and ash handling units, and automatic controls, include annual fuel consumption and operating costs. Bituminous Coal Institute.

273—Boilers & Stokers

Over 88 years experience are embodied in the design and construction of Scotch Marine type portable boilers says 28-page catalog. Photographs and cross-sections illustrate various models ranging in capacities from 6 hp up to 25 hp. Details and features of underfed stokers designed especially for this type boiler are described. The James Leffel & Co.

274—Draft Inducers

The biggest contribution to the cause of improved furnace operation in recent years has been the mechanical draft inducer, according to 12-page booklet I-52. Six causes of poor chimney draft are listed. Parts of a typical draft inducer installation are numbered and explained. L. J. Wing Mfg. Co.

275—Packaged Steam Generators

Construction of packaged steam generators is described in eight-page bulletin 1080. Auxiliary equipment is listed and a blueprint with dimensions of a typical boiler room is given. Ames Iron Works.

276—Off-Center Firing

Design features of a compact, automatic package boiler are discussed in four-page folder EC-1152. The theory of off-center firing, used with these units, is discussed. Specifications for units through 250 hp are tabulated. Dutton Boiler Div., Hapman-Dutton Co.

277—Coal Handling Equipment

Applications of coal handling equipment for the power plant, pictured in 40-page brochure 2416, illustrates the cumulative experience gained in thousands of installations over more than 75 years. Drawings show tested layouts for various operating conditions. Link-Belt Co.

278—Oil & Gas Burner

Described in 16-page bulletin ID53-102 is a factory-coordinated industrial fuel burning system. Built around an industrial burner for oil or gas firing, the system includes proper controls mounted in panels and wired to terminal-strips for easy connection, factory engineered windbox and refractory ring, fuel oil heaters, and trim. York-Shipley, Inc.

279—Combustion Processes

Too much or too little air can have costly effects in combustion processes. Bulletin "Oxygen-Index of Combustion Processes" points out that by using oxygen itself as the criterion to proper combustion, greater over-all efficiency, and more economy can be realized. Sample point location and equipment requirements are discussed. Arnold O. Beckman, Inc.

TO REQUEST FREE BULLETINS

Circle "key" numbers on Reply Card between pgs. 34/35 & 90/91. Your requests will be handled promptly.

280—Tube Cleaners

Bulletin 43 introduces a new geared tube cleaner for removing scale in heat exchanger and condenser tubes of ⅝ to 2½ in. ID. The unit is said to be particularly effective where conditions require low speed and extreme power. The Airetool Manufacturing Co.

281—Water Tube Boilers

Packaged water tube Type H boilers, shop assembled, are described in four-page folder 3M. Capacities, dimensions, and weights are listed in tables. Drawings show various views and elevations. The Bigelow Co.

282—Boiler Gaskets

Easy-reference flange gasket and boiler gasket dimension tables and bolting data are included in catalog AG-953. Shown are types for raised face, smooth face, crane-lap, and Van Stone joints, flange unions, male and female joints, and tongue and groove fittings for all standard makes of boilers. United States Gasket Co.

283—Small Capacity Boilers

Small boilers available in 15 to 40 hp for heating and processing are introduced in four-page bulletin A D-134. Advantages such as the new hinged front and rear doors, forced draft air system, four-pass construction, and electric control panel are shown by means of drawings and photographs. Cleaver-Brooks Co.

284—Liquid Level Indicator

Do you have to guess at your boiler water level? Nineteen-page booklet WG 1824 describes the Yarway Remote Liquid Level Indicator and shows how it is used not only for boiler water indication but for feed water and deaerating heaters, expansion tanks, hot flow softeners, and other similar uses. Yarnall-Waring Co.

285—Boiler Cleaning

Four fact-filled pamphlets explain how this company's products will help you solve algae problems, increase boiler efficiency with use of the Ever Clean boiler process, remove rust, and prevent corrosion. North American Mogul Products.

286—Boilers and Equipment

Sixteen-page bulletin SB-50, "Erie City Boilers and Allied Equipment," describes custom designed steam generators for central station or industrial application. A number of water tube types available as well as a line of fire tube waste heat units are pictured in cross section. Erie City Iron Works.

287—Flue Dampers

Booklet 1-HEA on curtain type dampers for flue gas control explains what the damper is and does, construction, dimensions, installations, and gives case histories. Description and applications are treated completely. Booklet shows drawings and photos of a variety of damper types. Heacon, Inc.

241—Two Drum Packaged Boilers

Two-drum, bent tube package boilers for steam, and high pressure, high temperature hot water are discussed in a four-page folder. Ratings, data, and dimensions are given in table form. Springfield Boiler Co., Div. of John W. Hobbs Corp.

242—Tube Expanders

Rolling and flaring tube expanders and operating accessories are listed in eight-page catalog 68. Illustrations, specifications, and recommendations are included. A useful guide for ordering is also presented. The Gustav Wiedeke Co.

243—Burners

The Roto-Press burner described in seven-page booklet 9101 is designed to meet the demand for maximum steam, automatic firing, minimum floor space, and elimination of high stacks. How to convert your standard rotary burner to a Roto-Press is explained. Combustion Equipment Div., Todd Shipyards Corp.

288—Automatic Combustion System

How the "Thermopack" Plan meets heating and power needs of those industrial and commercial plants capable of making oil burner or oil and gas burner installations on new and existing boilers with their own maintenance crews is described in six-page foldout 185. Preferred Utilities Mfg. Corp.

290—Boiler Selection

What to look for when you select a boiler is explained in six-page foldout BE3 by means of a phantom drawing of an automatic boiler. Typical installations are pictured along with photographs of units for light oil, heavy oil, gas, and combination gas-oil. Continental Boiler Div., Boiler Engineering & Supply Co.

291—Atomizing Oil Burners

The cheapest grades of oil or tar can be completely atomized and efficiently burned with Type SA steam atomizing oil burners according to 16-page bulletin 21. Models for various special uses are described. Furnace design and construction for efficient operation is stressed. National Airoil Burner Co., Inc.

292—Boiler Baffles

"More Steam from Your Boilers," a four-page folder, explains how streamlined baffles are applied to all types and sizes of the company's boilers. Drawings indicate how they are installed in each specific unit to secure crossflow of gases. The Engineer Co.

293—Packaged Steam Generators

Basic construction and design features of plant assembled steam gener-

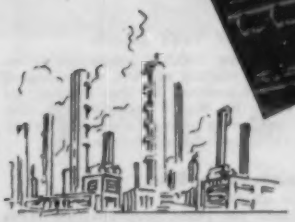
THIS 400,000 Pounds per HOUR

Vogt

STEAM GENERATOR

Gives Top Performance in a Leading Texas Petroleum Refinery

VIEW OF THE COMPLETED STEAM GENERATOR



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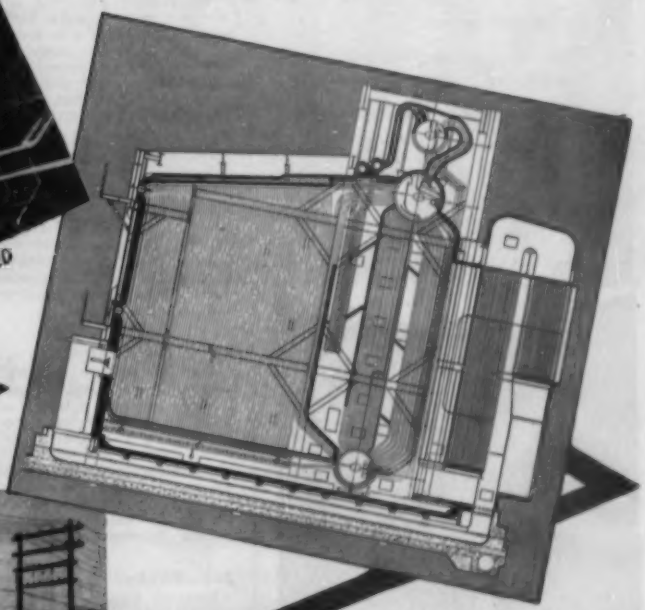

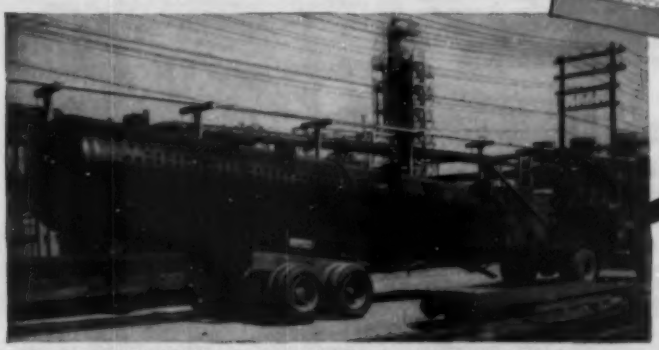

6'-6" DIAMETER x 37'-0" LONG STEAM DRUM BEING TRANSPORTED TO THE ERECTION SITE DURING INSTALLATION.

PRINCIPAL DATA

400,000 pounds per hour capacity.

Fusion welded steam and water drums designed for 700 lbs. S.W.P.

Superheater delivers steam at 750°F. total temperature.

Water cooled furnace.

Burners for Oil and Acid Sludge fuel.

Vogt builds a complete line of bent tube steam generators designed to burn solid, liquid, or gaseous fuels to meet specific operating conditions. Write for bulletins.

HENRY VOGT MACHINE CO., LOUISVILLE 10, KY.

BRANCH OFFICES: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va.

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Announcing . . . the great

LEWELLEN VARIABLE PULLEY

with all its NEW features

- Uses 40% less space
- Has 50% less overhung load
- Costs less per H.P.
- Has fixed or adjustable centers for horizontal or vertical shafts
- Scaled to new N.E.M.A. motors
- Fits present motors
- Engineered for smooth, quiet, trouble-free power transmission
- Built to Lewellen quality standards
- Fractional to 15 H.P.
- Up to 4 to 1 speed range with single variable pulley
- Up to 10 to 1 speed range with combination pulleys

LEWELLEN

TRANSMISSIONS • MOTOR PULLEYS

Service in variable-speed control exclusively for more than 50 years. May we help you?

LEWELLEN MANUFACTURING CO.

COLUMBUS, INDIANA

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bulletins

—Starts on page 34

ators, with or without superheat, are presented in illustrated 20-page booklet P6-51-2. Includes tables of engineering specifications for units from 10,000 to 30,000 lb steam per hr and design pressures from 250 to 825 psi. Also includes section on control and instrumentation. Foster Wheeler Corp.

294—Refuse and Wood Burning

Engineering data concerning spreader stokers installed to burn refuse or wood are contained in 24-page booklet 505. Stationary, manual dumping, power dumping, and traveling grate installations having maximum capacities from 10,000 to 275,000 lb steam per hr, steam or compressed air operated, are described. Detroit Stoker Co.

295—Heating, Pumping, Straining

Oil heating, pumping, and straining units for stationary plants, built into a unit on one base pan or a series of base pans, are described in six-page catalog 9429. The different arrangements necessary to meet individual boiler plant requirements are discussed in detail. Combustion Equipment Div., Todd Shipyards Corp.

296—Heated and Cooled Gages

Four-page data unit 237 covers special purpose heated and cooled gages and valves which are said to solve the problem of getting accurate level readings of liquids that boil or surge — or liquids that are heavy and don't flow at normal temperature. Cross sections and drawings show design and construction. Jerguson Gage & Valve Co.

244—Soot Blowers

Bulletin 1137 gives complete information on the Model G9B blower which employs a fixed position rotating element to clean a large number of tubes by sweeping through a pre-determined arc. The bulletin suggests the various uses for boilers, superheaters, reheaters, economizers, heat exchangers, and oil stills. The blower described is available for three pressure ranges up to and including 1900 psi. Diamond Power Specialty Corp.

245—Firebox Burners

Firebox boilers are discussed in bulletin 702. This four-page pamphlet describes the principle features and presents a detailed chart of dimensions and capacities. Boilers are available from 13 to 61 hp. Johnston Bros., Inc.

246—Boiler Service Valves

Surface blow, bottom blow-off, water column blow-off, and connections are covered in 23-page bulletin E125, with complete specifications, materials, and dimensions of each type. Valve operation is explained by illustration. Fire protection valves are included. Everlasting Valve Co.

247—Water Tube Boilers

According to this eight-page publication, standardization of design has made possible the manufacture of a modern, compact, and efficient water tube boiler of two-drum design. Designs are available for oil burning or stoker feed as well as gas. Bulletin 49-1 "Two-Drum Type S Steam Generators." The Wickes Boiler Co.

248—Automatic Burner

Newly designed automatic burner, model PK-84, for oil, gas, and oil or gas, is described in four-page folder 430. Safety features are listed and the unit's integrated design is explained. For capacities to 42,000 lb steam per hour, the burner is described as a complete, automatic combustion unit including burner, blower, and controls. Peabody Engineering Corp.

BUILDING MATERIALS & MAINTENANCE

297—Iron Cements

Suggestions for simple reliable repairs on equipment and piping using iron cement are presented in 40-page pocket-size pamphlet. Patching cement, aluminum and bronze cement, concrete paint, gaskets and clamps are also presented. Also included is a folder describing how to apply concrete paint No. 15, for interior or exterior use. Smooth-On Manufacturing Co.

298—Thread Compound

A data sheet gives complete information on C-5 "Hi-Temp" thread compound. A sample will be sent along with the data sheet. Felt Products Manufacturing Co.

299—Flooring

"Handbook of Building Maintenance," gives valuable information on keeping your plant in efficient working order. Instant-Use concrete floor patch is described with suggestions for its use, along with other materials for repairing floors. Flexrock Company.

TO REQUEST FREE BULLETINS

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249—Condenser Tube Inserts

How to restore leaking condenser tubes to service by sealing off the deteriorated portion with inserts, is the subject of four-page leaflet 500. Tube cleaners, expanders, and maintenance tools are listed. Thomas C. Wilson, Inc.

289—Maintenance Book

"Genius at Work," is a handy booklet full of ideas for plant maintenance. This company has developed Kroil, a chemical for loosening frozen parts. Kano Labs.

COMPRESSORS & BLOWERS

300—Compressors

Horizontal heavy duty air and gas compressors, Type T, are described in 15-page bulletin 728-8. Cross sections of crankshaft, inlet valve unloading system, compressor cylinder and valves, and the complete compressor add to the value of the booklet. Chicago Pneumatic Tool Co.

CORROSION CONTROL

301—Rubber Linings

Application of rubber lining to prevent corrosion of tanks, pipes, and valves is discussed and pictured in four-page folder. In addition, two-page reprint tells how rubber lining can stop circulating pipe corrosion. La Favorite Rubber Manufacturing Co.

302—Transmission Line Corrosion

"Corrosion Control of Electrical Structures and Equipment," 17-pages, is designed to give the field operating men of electric light and power companies practical painting information on all phases of transmission and distribution work. Photographs are used to show the protection that can be expected from this company's paint products. Subox, Inc.

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bulletins

—Starts on page 94

DIESEL & GAS ENGINES

303—Dual Fuel Engines

In 36-page bulletin S-500-B787 are photographic examples of each application, together with vital statistics, case histories, and comments on fuel consumption for dual fuel engines. Each feature is treated separately: the dual plunger fuel injection pump; automatic fuel switcher; automatic thermal air control; and the Micrometering gas valve. Worthington Corp.

304—Two-Cycle Diesels

Handy for filing and reference purposes, a series of data sheets gives condensed information and specifications on the full line of P & H two-cycle diesel engines. Each model or engine and power unit is pictured and discussed in a separate bulletin. All models, from 20 to 138 hp, 2, 3, 4, and 6 cylinders are included. Harnischfeger Corp., Diesel Div.

305—Air Pollution Control

How catalytic exhaust systems remove noxious carbon monoxide and irritating hydrocarbon fumes from exhausts of internal combustion engines is explained in this four-page folder. The new Dieseler exhaust which cuts smoke, odors, and CO content of 4-cycle diesel engines is also described. Oxy-Catalyst, Inc.

ELECTRICAL EQUIPMENT

306—Dry Type Transformers

How to use dry type transformers profitably in your plant is explained in folder DT 195 which also includes wiring diagrams. Acme Electric Corp.

307—Circuit Breakers

"What You Should Know About Circuit Breakers," 16-page manual 101, explains the operating principles of basic circuit breaker design. Included are simplified diagrams of three basic types. Explanations, charts, and diagrams deal with temperature factors, inrush current effects, and reset time. Heinemann Electric Co.

308—High Load Fuses

Hi-Cap fuses for the protection of loads above 600 amp are described in six-page bulletin HCS. Two handy charts are included: Current Limiting Effect and Opening Time Curves. Use of these fuses in conjunction with Fusetron fuses is explained. Bussmann Manufacturing Co.

309—Low Voltage Switchgear

Bulletin 6004 A is a 24-page guide to I-T-E low voltage switchgear. Illustrated with diagrams and photographs, booklet is full of information on features, switchgear components, applications, specifications, and construction data. It also describes extra services which are available to users of switchgear. I-T-E Circuit Breaker Co.

310—D-C Power Sources

D-c power sources and supplies are described in eight-page booklet B-1049. e-chanical and electrical specifications are given for the Nobratron. Sorensen and Company, Inc.

311—Air Circuit Breakers

Bulletin 5107-DR-1 contains four pages of facts, figures, features, and photographs on types KA, KB, KC, and LG Urelite air circuit breakers. There is also information on weather-proof and dust-tight enclosures, plus applications, specifications, and construction details. I-T-E Circuit Breaker Co., Switchgear Div.

312—Commutators and Slip Rings

"Commutator and Slip Ring Maintenance," 39-page handbook, covers trouble shooting, brush maintenance and operating procedure, and general maintenance. Illustrations show the operations described. Ideal Industries, Inc.

313—Light Dimming Equipment

Light dimming equipment, available as packaged assemblies, is the subject of 12-page bulletin D651P. Described are units for different numbers of circuits requiring up to 2000 w each, and for various types of a-c operation. Wiring diagrams are included. The Superior Electric Co.

314—Flexible Conduit

Extra flexible Sealtite conduit for electrical wiring of machine tools and industrial equipment is pictured and described in four page pamphlet EF-531. It points out the fact that this liquid-tight, extra flexible conduit is approved for these uses by the Joint Industry Council. American Metal Hose Branch, American Brass Co.

381—Renewable Fuses

Sixteen-page bulletin S-40 describes the Economy De-Lay renewable fuses which are said to give safe and dependable time-delay on overloads. For every requirement, these fuses have inexpensive links which are easily replaced. Economy Fuse & Manufacturing Co.

382—Power Factor Correction

Booklet 50B, 27 pages, describes the Unit-Cell Box Type Capacitors which offer easy-to-install, economical means of correcting low power factor for large or small power consumers. Typical wire connections are shown. Sprague Electric Co.

385—Transformers and Substations

Thirty-five years of experience in the aircooled transformer field has resulted in the modern dry-type transformers and unit substations pictured in 11-page bulletin 353-A. Component parts are illustrated and their operation explained. Sorgel Electric Co.

ELECTRIC UTILIZATION

315—Motors

Advantages of the various types of motors made by this company are given in four-page folder 23. Descriptions of single-phase and polyphase motors are included along with a listing of their specifications. Wagner Electric Corp.

316—Variable Speed Motors

How variable speed motors are used to improve production is described in 16-page brochure 1797. In addition to describing advantages the booklet describes design theory and construction features. Special controls, including both mechanical and electrical types, also are discussed. U. S. Electrical Motors, Inc.

317—Motor Control Center

Savings in space and expense and improved performance is explained in 12-page bulletin 170. Electrical and constructional details of these groups of combination motor starters and their components are fully described. Arrow-Hart & Hegeman Electric Co.

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Stops Losses Caused by OVER-heating

POWERS No. 11 Temperature INDICATING REGULATORS
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SIMPLIFY your temperature control problems with Powers No. 11 Regulators. They're easy to install. Use them wherever you want a rugged, self-operating control to maintain a constant temperature. Better Temperature Control—and years of dependable service are assured by: (1) Easy to read 4" dial thermometer shows temperature of liquid or air being controlled, makes it easy to adjust regulator for proper temperature. (2) OVER-heat protection. (3) Has valve stem lubricator. (4) Temperature adjustment has OILITE thrust bearing.

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Petro follows fluctuating load demands with speed and reliability . . .

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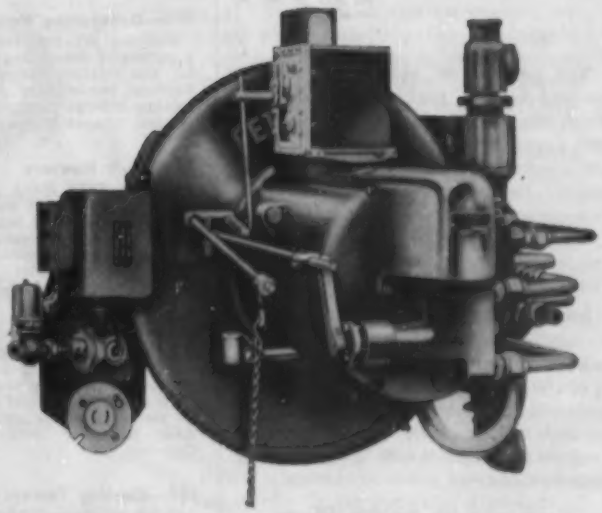
For economy, for performance, for trouble-free service you just can't beat Petro firing. See the Petro section in Sweet's Architectural File, or write for catalog and specifications. Petro, 3027 West 106th Street, Cleveland 11, Ohio. In Canada: 2231 Bloor St. West, Toronto, Ontario.



Rotary type. Burns low-cost heavy fuel oil with complete reliability. Capacities up to 200 gallons per hour. Combination oil-gas models also available, and complete forced draft packaged units.

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—Starts on page 94

HEAT EXCHANGERS & WATER HEATERS

318—Injection Water Heaters

Steam injection water heaters with the pressurizer piston for safe, quiet, automatic control are described in four-page pamphlet WH12A. How the unit saves space, time, fuel, installation, and maintenance costs is explained. Specifications for the seven standard sizes—for both direct and accumulator application—are given in tables. Pick Manufacturing Co.

319—Pipe and Fin Coils

Revised second edition of the "Engineering Data Book on Pipe and Fin Coils" contains such information as calculation of pipe and fin coils, heat transfer coefficients for heating or cooling, factors for computing fin coil surfaces, recommended materials for heating or cooling, heat transfer factors at various air velocities, and Btu load limitations for cooling coil circuits. Rempe Co.

383—Heat Exchangers

Bulletin 120 describes the operation of the Aero Heat Exchangers used in cooling or controlling of temperatures of industrial liquids. It shows the operation of this equipment by means of diagrams and examples of application by installation photographs. Niagara Blower Co.

384—Deaerating Heater

Bulletin WC-112, four pages, describes a packaged deaerating heater, spray type, for the smaller steam generating plants. Vertical two-minute and horizontal ten-minute storage units are shown in cross section. Graver Water Conditioning Co.

386—Unit Heaters

Catalog CUH 846-A gives the complete story on Grid unit heaters. Catalog BC-1040 describes Grid blast coils for process drying. How the construction of the unit heaters prevents electrolytic corrosion is explained in booklet "Corrosion in Unit Heaters." D. J. Murray Manufacturing Co.

387—Water Heaters

A streamlined system of heating water and process liquids quickly and at low cost is explained in this bulletin. The Instant Heater described eliminates the need for reducers. Cross-sectional drawings explain how the unit operates. Johnson Corp.

388—Cooling Towers

Quick reference list of available literature on line of cooling towers and auxiliary equipment is contained in 4-page folder 1.19.092B. Types of cooling towers include mechancial draft, package type and atmospheric. Auxiliary equipment includes fans, fan drives and throats, louvers, and spray nozzles. Gas and air treating and heat exchanger equipment also are listed. J. F. Pritchard & Co.

389—Heaters

Horizontal and vertical heaters in steel, copper lined, copper-silicon, cement lined, clad and galvanized construction, as well as the low-flow design are each cataloged as to weights, dimensions, construction details, and capacities—with conversion tables, in 48-page catalog 18. The Patterson-Kelley Co., Inc.

INSTRUMENTS & CONTROLS

320—Gage Catalog

The four important questions to ask before you buy gages are listed in comprehensive 68-page catalog 64. Whether you need gages for replacement on operating equipment or for installation on new equipment, you will find complete information with drawings and specifications in this booklet. United States Gauge Div., American Machine and Metals Inc.

321—Temperature Regulators

Bulletin 330 fully describes a simple, self-operating temperature regulator for plating, anodizing, bonderizing, pickling, cleaning and rinsing solutions. The Powers Regulator Co.

322—Flow Meters

Important data on the Diaflow Meter, for measuring air flow, gas flow, and the ratio between the two flows, are presented in eight-page booklet 52-1017-37. According to the booklet, the meter is particularly well suited for industrial furnaces and also for sewage disposal plants. The Hays Corp.

323—Gages & Thermometers

Large variety of recording, dial indicating, transformer and freezer thermometers and pressure, vacuum and compound recording gages are described and illustrated in eight-page bulletin G13C. Also four pages of operating instructions for recording gages, and complete price list. Electric Auto-Lite Co., Instrument & Gauge Div.

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324—Temperature Regulators

Recommended installations of temperature regulators for instantaneous water heaters, storage water heaters, and forced air heating systems are shown in three line drawings in four-page folder 1008. Spence Engineering Co., Inc.

325—Flow Meters

Section on flow approximations and flow meter installation information makes 56-page catalog 2320 a valuable reference manual. It also describes all types of flow meters made by this company's Industrial Div., including indicating, recording, integrating, and controlling instruments of both evenly graduated and square root types. Minneapolis-Honeywell Co.

326—Telemetering

Two wires do the work of sixty in a new simple telemetering system developed by this company, according to this four-page folder. Known as the Telestep, the unit is for the automatic remote control of municipal and industrial water and sewage treatment. Sample problems and solutions are given. Automatic Control Co.

327—Feedwater Gas Analyzer

Described in four-page folder 148BP is an analyzer for measuring dissolved oxygen and hydrogen in feedwater. Advantages, ranges and accuracy are discussed. Cambridge Instrument Co., Inc.

LUBRICATION

328—Force Feed Lubricator

Automatic force feed lubricator Model "94" described in 11-page booklet 94-C will pump against any steam or air pressure up to 1500 lb and will handle any grade of oil from the lightest mineral

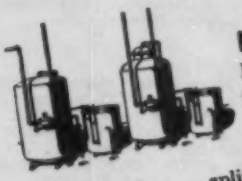
Twice the man he was!

The Elgin-Refinite man in your vicinity has a lot more for you than he had as an Elgin man or a Refinite man. The joining of Elgin and Refinite in October 1953 places at his finger tips the most comprehensive water conditioning service ever offered to industry.

He now has behind him the accumulated experience of two old-established firms. He has behind him an unequalled range of water conditioning equipment and methods. He has the ways and means to "make over" your raw water into a "finished product" having the exact characteristics you require.

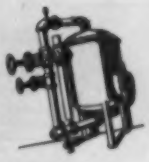
Do not underestimate the importance of this newly broadened service. Most water conditioning mistakes are a result of single track thinking by firms limited to one or two approaches to the problem. With complete freedom to choose the *best* way from *all* ways, Elgin-Refinite can solve your water conditioning problem the most effective and *economical* way.

It would take many pages to cover the range of Elgin-Refinite service, but we briefly outline opposite how much more Elgin-Refinite has to offer in the four basic categories of water conditioning. To know what this broader service means to you, write us, or put your problem up to the Elgin-Refinite man.



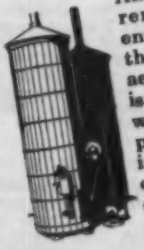
Ion Exchange Equipment

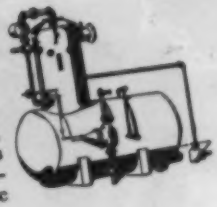
From sodium zeolite to complete deionization and silica removal, the Elgin-Refinite line is complete: The famous "Double-Check" zeolite softener . . . zeolite-alkalinity neutralization . . . split stream sodium and hydrogen zeolite softening with degasification . . . the Ultra-DeIonizer providing distilled water quality at a fraction of the cost.



Filtration in all phases

Diatomite filters . . . sand filters . . . activated carbon filters . . . anthrafilt filters for every use ranging from municipal water works and swimming pools to oil removal and many other applications.





Aeration, Degasification, and Deaeration

All types of equipment for removal of dissolved and entrained gases from water through degasification and aeration. A big efficiency gain is made by deaerating heaters which supply make-up water, preheated by exhaust steam, in which carbon dioxide is eliminated and oxygen is reduced to less than 0.005 cc per liter.

Lime-Soda, Coagulation, and Clarification Whether it's simple clarification, cold lime soda or hot lime soda, Elgin-Refinite has the efficient answer. Hot lime followed by zeolite eliminates excess chemical dosage or after-treatment regardless of operating variations. Packaged and specially engineered equipment.

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—Starts on page 94

to the heaviest cylinder stock. Manzel Div. of Frontier Industries.

329—Petroleum Products

Brief descriptions of the leading products this company produces for industrial use are given in folders A-2894 and A-2951. These products include hydraulic oils, metalworking coolants, heat transfer oils, and many others. Sun Oil Co.

330—Non-Fluid Oil

This constructive bulletin explains the uses and advantages of Non-Fluid Oil. According to this booklet, it cannot clog fittings, it lubricates until entirely consumed, and will not separate under pressure. A free testing sample of the oil will be sent with the literature. New York & New Jersey Lubricant Co.

331—Oil Reclaimer

Subject of four-page folder R-247 is a self-contained, compact oil reclaimer for keeping industrial oils free from contaminants. In addition to describing how the process works, the bulletin suggests applications. The Hilliard Corp.

370—Oil Filters

'Filters and Purifiers for Oil Circulating Systems,' 16-page reprint from the magazine "Lubrication" for March, 1954, discusses the contaminants encountered with oils in service and the detrimental effects associated with them. Oil oxidation and extraneous matter is listed. Selection of equipment and maintenance of the various types is fully discussed and tied in with fields where oil conditioning equipment is a must. The Texas Co.

MATERIALS HANDLING & STORAGE

332—Storage Bins

If you specify vertical storage construction for handling flowable bulk materials, this ten-page foldout will help you visualize how this company's Super-Concrete Stave Storage Bins might meet your requirements. The booklet contains photographs of typical installations, lists uses, and explains construction. The Neff & Fry Co.

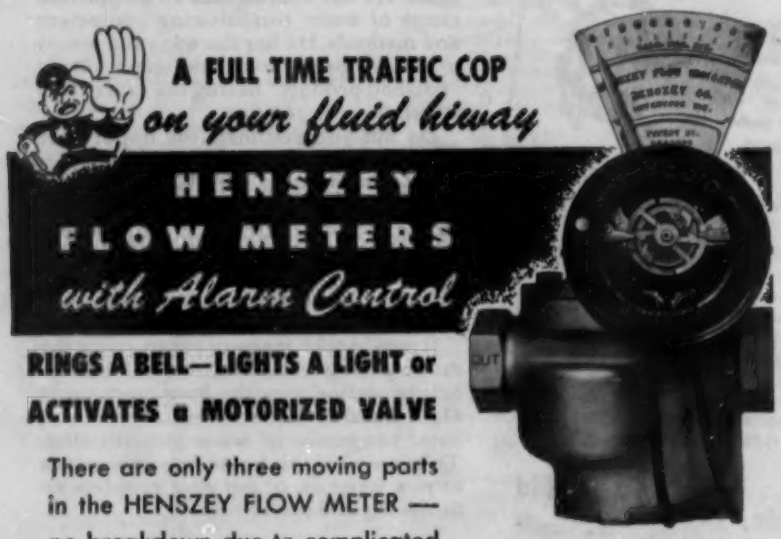
METALS & WELDING

333—Steel Weldments

New close-tolerance machinery illustrated in this four-page folder makes it possible for this company to produce single components or complete assemblies to your plant's specification. Examples of equipment designed and engineered by this company are also given along with suggestions as to cast parts that can be replaced by fabricated steel weldments. The Foster Co.

334—Nickel Alloys

Helpful technical publications covering the many aspects of nickel alloys, and their applications, are listed in two bulletins. Instructions on how to order literature, free of charge, are included. The International Nickel Co., Inc.



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There are only three moving parts in the HENSZEY FLOW METER — no breakdown due to complicated gears and mechanism. Goes right in the line — no additional supports. Indicates flow within 3% absolute accuracy, even with pulsating flow. Send for bulletin.

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Easy to set on face of switch — unaffected by dust, dirt or corrosion — no pitting or sticking.

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PIPING, VALVES, & SPECIALTIES

335—Pipeline Heating

Pipeline applications of Calrod tubular heaters in industry are shown in photographs and drawings in eight-page bulletin GEA-5095A. A comprehensive chart gives heat losses of various metals. General Electric Co.

336—Separators & Purifiers

Live steam, exhaust steam, air and gas, and receiver type separators, and steam purifiers and exhaust heads are described in 24-page catalog 500. Charts give pressure drop, steam capacity, and air capacity. Wright-Austin Co.

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338—Pipeline Expansion

Catalog 135, 24 pages, is packed with engineering applications and selection data necessary to the proper solution of pipeline expansion problems. The center spread is devoted to a schematic piping layout illustrating expansion joint application and principles. Flexonics Corp.

339—Tubing Steel

One of the alloy tubing steels widely used in elevated temperature service is discussed in a technical data card TDC-151. Known as B&W Croloy 9M (8 to 10 percent chromium, 1 percent molybdenum), tubes of this alloy have been used successfully in a broad variety of petroleum conversion equipment. Included are data on mechanical and physical properties, bending, welding, and heat treatment. Tubular Products Div. of Babcock & Wilcox Co.

340—Valves

Needle, globe, plug, check, relief, and special valves are described in 44-page catalog 352A. Units listed are made of various metals, and are suitable for instrumentation, processing industries, hydraulic systems, and industrial applications. Details of construction are shown, and complete specifications and dimensions are given. Republic Manufacturing Co.

341—Steam Trap Problems

"Solving Steam Trap Problems," revised 36-page catalog T-SM254, includes information on the new combination float and thermostatic traps, which vent air in one-eighth the time of standard inverted bucket traps. The booklet also tells how to calculate condensation loads and select traps. V. D. Anderson Co.

342—Pipe Repairs

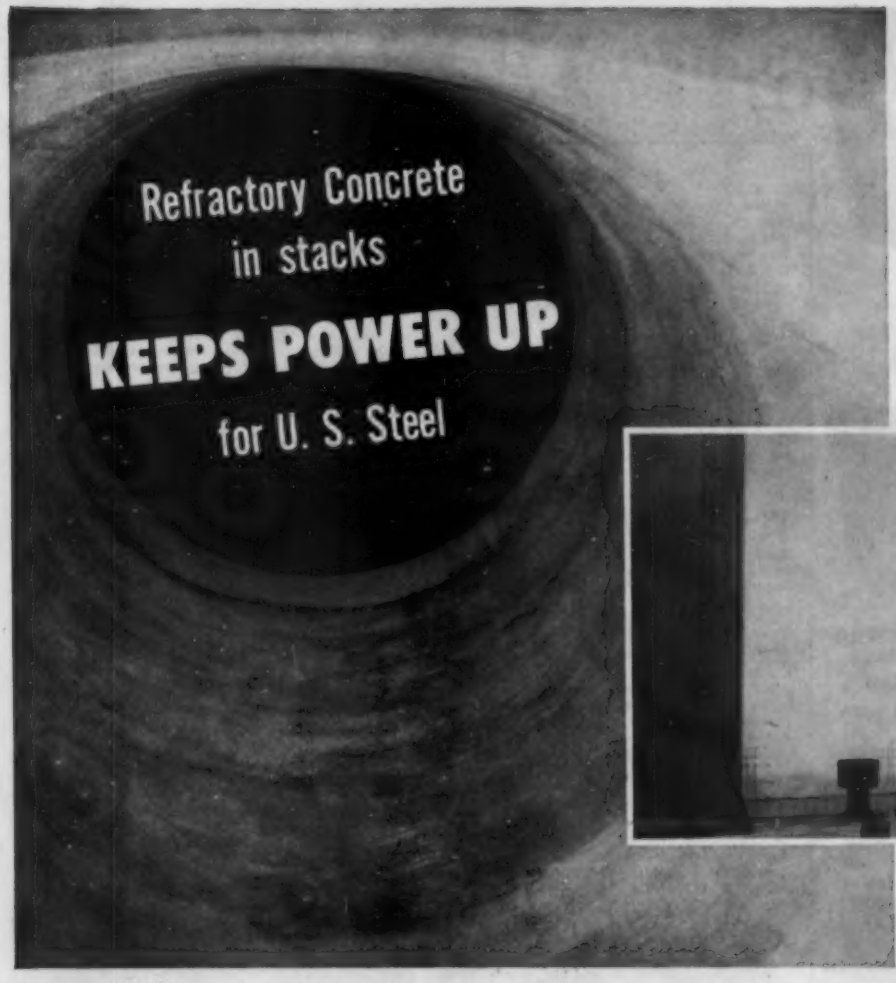
Catalog 54, 27-pages, is a valuable source book of information on the repair of all types of leaks in water, steam, gas, oil, ammonia, and brine lines. According to the booklet, pipe replacement, steam fitting labor, and operating shut-downs are eliminated in most instances by use of this company's line of pipe repair clamps. M. B. Skinner Co.

343—Float Traps

If you are planning to install low, medium, or high pressure float or float and thermostatic traps, you will need this illustrated catalog sheet. According to the data sheet, once these valves are installed, there is no necessity for the breaking of any pipe connection for servicing. Hoffman Specialty Manufacturing Corp.

344—High and Low Pressure Valves

Catalog 10 describes List 900 and 900



FAST WORK—Each 14′ 10″ i.d. x 61′ 6″ high stack got a 2½″ lining of Refractory Concrete in just 4 days after reinforcing wire mesh was attached. Concrete made with Lumnite Cement and traprock was "shot" on by cement gun.

You're looking down

the smooth, jointless Refractory Concrete lining that protects a power stack at the new Fairless Works. It's the way U. S. Steel assures long, trouble-free stack life. Here's why:

Saves time. Fast, monolithic construction is further speeded by the ability of Refractory Concrete made with Lumnite* Cement to reach service strength in 24 hours or less! *Helps draft.* The one-piece lining prevents "breathing." *Gives long-lasting protection.* Lumnite-made Refractory Concrete resists attack of sulphurous gas and abrasive fly ash, takes heat to 2600°F, has low volume change and withstands thermal shock.

Whether you're lining or rebuilding a stack, it will pay you to look into the enviable record of Refractory Concrete made with Lumnite calcium-aluminate cement—in power, metals and refining industries . . . in fact, wherever heat, corrosion or abrasion are problems.

FOR CONVENIENCE, you may prefer to make Refractory Concrete with prepared castables (Lumnite Cement plus aggregates selected for specific temperature and insulation service—add only water). They're made by refractory manufacturers and sold through their dealers. For more information, write Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, N. Y.

**"LUMNITE" is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

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REFRACTORY, INSULATING, OVERNIGHT, CORROSION-RESISTANT

UNITED STATES STEEL HOUR — Televised alternate weeks — See your newspaper for time and station

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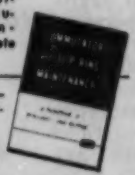
Keeps motors running like new... The easy, fast way to restore commutators and slip rings — WITHOUT DISMANTLING! — Substitutes low-cost prevention and correction for high-cost repair and rebuilding — COSTS LITTLE, SAVES A LOT.

RESURFACERS
Refinish commutators and rings to like-new condition even when ridged, scored or burned.

MICA UNDERCUTTERS
Stop sparking — help commutation — prolong brush life. For all sizes of commutators.

PRECISION GRINDERS
For more than surface smoothing—under machine's own power. Accurate to .001".

FLEXIBLE ABRASIVE
Cleans and burnishes commutators. Non-dusting. Complete size range.



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bulletins

—Starts on page 94

valves. The 900 is for a pressure range of 2000 lb at 100 F to 380 lb at 1000 F. The 900 is for higher pressures. According to the booklet, these valves offer extra protection against excessive stress with extra-strong stem and wedge-gate connection. Chapman Valve Manufacturing Co.

345—Pilot Operated Valves

How control function of a pilot-operated valve can be changed by using a different sensitive pilot is explained in four-page folder 700. A large cutaway illustration of the valve and a detailed description of design features are included. Spence Engineering Co., Inc.

391—Reducing Valves

Four-page folder 511-A lists actual small flow reducing valve capacities based on test data. Cross-sectional drawings show construction of the bronze and steel valves. Leslie Co.

346—Rubber-Lined Pipe Joint

Nine-page handbook presents basic principle, design features, method of installation, plus parts and tools needed to utilize the Gaco rubber-lined pipe system. It compares cost of Gaco and flanged pipe installations. Gates Engineering Co.

392—Flow Meters

With an alarm control, the flow meters described in this bulletin have only three moving parts. How they operate to ring a bell, light a light, or activate a motorized valve is explained by means of illustrations. Henszey Co.

393—Piping Layout

How to plan an industrial waste treatment system is described in "Piping Layout No. 70." The booklet includes diagrams, specifications, and other detailed engineering data. Jenkins Brothers.

394—Pipe Joint Compound

A sample of the compound will be sent with the literature on this waterproof sealer for pipe and joints carrying water or low-pressure steam. Key Company.

395—Regulating Valves

Bulletin 1-A, 32 pages, gives complete information on a wide range of regulating valves for steam, water, air, gas, or oil. Illustrations, cross-sectional drawings, and specifications are included. Atlas Valve Co.

396—Prefabricated Conduit System

Introduced in four-page folder 5210 is a newly developed large diameter, prefabricated conduit system for protection of underground services. Prefabricated to job requirements, it contains piping for steam, condensate, water lines, fire lines, or process purposes all in place and insulated where required. The Ric-wil Co.

397—Steam Trap

The Drainator steam trap with no moving parts is described in this illustrated bulletin. Advantages, such as the fluctuating gage glass which signals when the trap is functioning properly, are discussed. Coe Manufacturing Co.

Torque Wrenches

Both inch-pound and foot-pound torquers are described in this complete 68-page catalog. Types included are for a wide range of drive sizes with plain or ratchet head. **Please send requests directly to Proto Tool Co., Dept. IP, 12701 Santa Fe Ave., Los Angeles 54, Calif., with 10c.**

398—Pipe Hangers

This hanger catalog describes the complete line of adjustable pipe hangers and supports made by this company. Specifications, drawings and engineering data are included. Grinnell Company, Inc.

399—Welded Floats

Units made of stainless steel, monel, and chrome plated steel, in spherical, elliptical, and cylindrical shapes are shown in eight-page bulletin 753. Sizes from 2 to 14 in. dia for pressures from vacuum to 4800 psi are listed with weights, buoyancies, and collapsing pressures. W. H. Nicholson & Co.

400—Flexible Metal Hose

For what purpose do you use flexible metal hose? Whatever your application, you will find valuable information about job tested and certified hose in catalog 800. Included are data on steel, stainless steel, monel, and bronze hose in sizes 1/3 to 36 in. ID. Atlantic Metal Hose Co.

337—Trapping Practice

Engineers concerned with steam traps should find 48-page catalog J a valuable source of data on recommended trapping practice. In addition to explanation of how to calculate condensate loads and select traps, a maintenance section covers installation, preventive maintenance, trouble shooting, and repair. Armstrong Machine Works.

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POWER TRANSMISSIONS — MECHANICAL

347—Belt Conveyor Design

Engineering data required to design a belt conveyor for any application are presented in 96-page catalog 852. The booklet, published to serve as a handbook on conveyor design, states that many problems can be answered by using a standardized unit. The Jeffrey Mfg. Co.

348—Rayon Belting

Transmission belting with rayon instead of cotton plies was proved in field applications for more than four years on jobs specially selected for their severity according to four-page folder AS163W. Uses and advantages of Thor belting are listed. Goodyear Tire & Rubber Co.

349—Flexible Couplings

Flexible couplings which never require lubrication are shown in 19-page bulletin 1009. Valuable engineering data for each type of coupling are given in table form along with drawings and application. Lovejoy Flexible Coupling Co.

350—Steel Collars

Steel shaft collars are shown in use on industrial lift trucks, printing presses, textile machinery, and other industrial equipment. Advantages of this type of collar are listed and a specification table is included. Standard Pressed Steel Co.

401—Eddy-Current Machinery

"Basic Principles of Eddy-Current Machinery," a section of 15-page bulletin GBI, explains the fundamental principles

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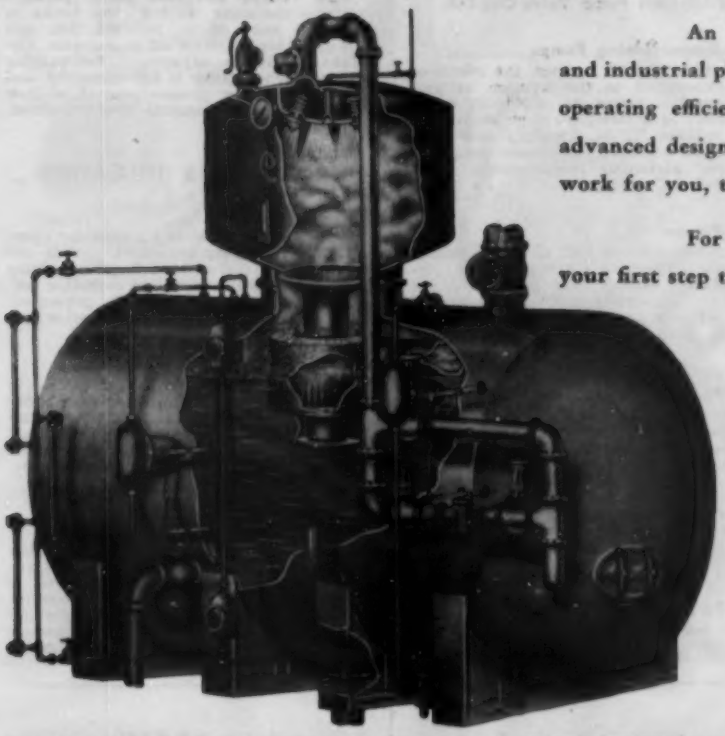

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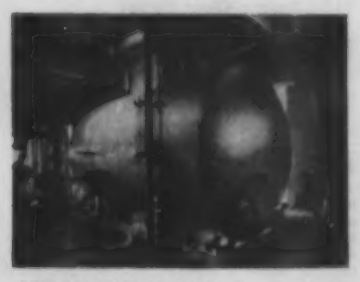
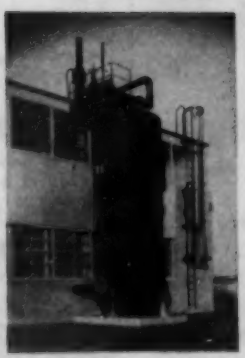
For technical assistance write or call Belco — your first step to lower costs.



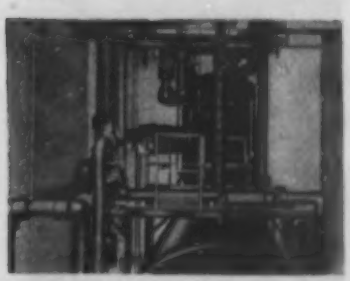
SPRAY TYPE — Belco Deaerator in large eastern oil refinery. Has a capacity of 300,000 lbs/hr.

MARINE TYPE — Typical Belco marine heater furnished to shipyards. (Approved by Lloyds of London)

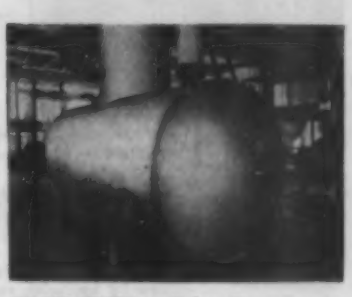


OPEN TYPE — Deaerator at large eastern pharmaceutical plant. Capacity of 80,000 lbs/hr.

VACUUM TYPE — Unit shipped set-up to midwestern utility. Has 150,000 lbs/hr capacity.



SPRAY TRAY TYPE — Belco Deaerator at New York State institution boiler house. Capacity 120,000 lbs/hr.



TRAY TYPE — Belco Deaerator at southern municipality. Has a capacity of 125,000 lbs/hr.

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bulletins

—Starts on page 94

of generating torque by means of eddy-current devices. Another section, "Characteristics of Rotating Equipment," contains engineering data. Dynamatic Corp.

PUMPS

351—Opposed Impeller Pump

How opposed impellers balance axial thrust is covered in 12-page brochure 1902. Sizes from 2 to 4 in., with 2 to 8 stages, are presented for capacities to 1000 gpm, pressures to 1200 psig, and temperatures to 350 F. DeLaval Steam Turbine Co.

352—Rotary Gear Pumps

"How to Solve Pumping Problems," is the title of 36-page booklet 3060. In addition to presenting typical problems and their solutions, various types of rotary gear pumps are described. The major portion of the book is intended to serve as a data handbook. Geo. D. Roper Corp.

353—Packings

Darcova pumcups, which permit equipment to be operated at reduced speeds, are described in two bulletins: No. 4502 on Pumcups for air or hydraulic mechanisms; and 4401 on units for reciprocating pumps. How these units decrease maintenance and lower operating costs is described. Darling Valve & Mfg. Co.

354—Pump Valves

Pump valves and graphite packings are described in 24-page brochure SC-510. Types, details of construction, design features, applications, how to order, and dimensions are included. Heaters for heating water by blending with steam are also presented. Sims Pump Valve Co., Inc.

355—Proportioning Pumps

Design of the "K" pump, the result of long experience in the solution of proportioning problems, is shown in detail by means of a two-page foldout in five-page bulletin KP-54. Capacity and pressure tables will help you choose the pump for your particular requirements. Hills-McCanna Co.

356—Pumps

Condensed catalog "M" describes pumps for every purpose. Among those described are: turbine type pumps for use with small capacities and high heads; and type 66U side suction centrifugal pumps. Aurora Pump Co., Div. of New York Air Brake Co.

357—Package Feeder

Proportioning pumps and package chemical feeding units are described in this four-page folder. With liquid ends available for about 85 percent of all chemical pumping requirements, the pump is designed for use where a controlled capacity of fluid is necessary. How the feeding unit can be connected to the piping of your plant and to the electrical control equipment is explained. Bird-Archer Co.

402—Turbo Pump

Each component of the type DE turbo pump is pictured and its design advantages explained in a six-page folder. The lubrication system is also described in detail. Typical uses are listed. The J. S. Coffin, Jr., Co.

403—Pump Package Systems

This catalog describes pump package systems including welded steel tanks in standard sizes of 50, 100, 175, 250, and 500 gal complete with all accessories. The Manajust Stroke adjustment for varying capacity when pump is not operating, and the Autajust for precise control of flow while pump is running are explained. Orchem Pump Div.

REFRACTORIES & INSULATION

358—Refractories

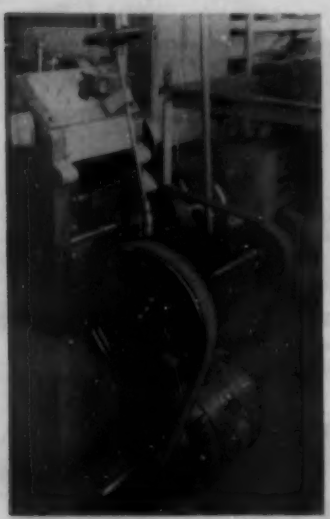
Charts which show at a glance the properties of refractory castables, plastics and mortars are featured in 20-page catalog R-22. Important information including recommendations for each is presented. Babcock and Wilcox Co., Refractories Div.

359—Refractories & Insulation

Catalogs R-52 through L-93, compiled in a binder, form an illustrated 40-page booklet showing where, when, and how to use various types of materials for industrial heat generation and processing equipment. An index is included for quick reference. Refractory & Insulation Corp.

360—Heat Resistant Concrete

Useful engineering data and information pertinent to the structural design of refractory and heat-resistant concrete is contained in illustrated 12-page booklet PP-5M. Subjects such as strength, volume changes, methods of reinforcing, sprung arches and domes, application to ducts,



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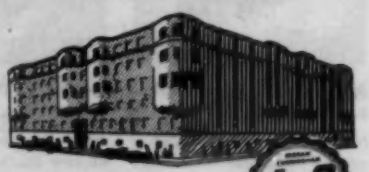

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"We had a picnic on the boiler room floor"

"When the Chief Engineer recommmended coal-burning boilers for the new plant, one of the directors asked if coal wouldn't make the plant dirty.

"That made the Chief mad! He didn't say anything at the time, but at the first board meeting after the new plant was finished he invited the directors down for lunch.

"You should have seen their eyes! The place was hospital clean. And why not? The coal came into the stoker through dust-tight chutes, and the ashes were piped out through pneumatic tubes.

"While the directors were eating, the Chief gave them a chalk-talk. On one side of the blackboard he had charted the savings through the use of of coal as compared with other fuels. On the other side he had a comparison of our proven reserves of the various fuels showing that while other fuels are growing scarcer, we have barely scratched the surface of our almost inexhaustible coal deposits."

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As the world's largest carrier of bituminous coal, the C&O is intimately familiar with every phase of coal use. We have a large staff of experts who will gladly help you to locate the coal best suited to your needs; to help you use it most efficiently; to help get it to you promptly.

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bulletins

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and stack linings are dealt with. Universal Atlas Cement Co., Lumnite Div.

404—Industrial Insulation

"J-M Products for the Process Industries," eight pages, is arranged as a ready reference for men responsible for the design, installation, and operation of process equipment. It gives concise data on the properties of the various products and includes photographs showing typical installations. Johns-Manville Corp.

TURBINES & STEAM ENGINES

405—Steam Turbines

If you use steam for heating, cooking, or processing, you can get power at almost no cost with the use of a Wing steam turbine according to bulletin SW-1a. Construction of these units gives an almost infinite range of speeds, easy control by throttling, and the units are independent of any electric power failure. L. J. Wing Mfg. Co.

361—Steam Turbines

Fully-illustrated 36-page bulletin 1961 emphasizes the flexibility of design of the Type-S turbine which is said to make possible selection of the proper number of stages, governor, and controls to give maximum efficiency for your steam and operating conditions. Worthington Corp.

362—Multi-Stage Turbines

Smaller framed, multi-stage turbines are featured in six-page bulletin. Overspeed governor, governor valves, blades, diaphragms, and many other design features are discussed and illustrated. The Terry Steam Turbine Co.

363—Steam Turbine Selection

Full details of this company's steam turbine are given in bulletin 135. Drawings and installation photographs point out the special features. How to save operating and maintenance costs by buying the right size for individual needs is explained. Coppus Engineering Corp.

364—Turbine Speed Control

"Fundamentals of Turbine Speed Control," 32-page brochure H-21, is an educational piece intended to clarify the operation of common types of automatic speed control for steam turbines. Simplified diagrams illustrate operating principles of actual control systems. Elliott Co.

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WASTE DISPOSAL

365—Waste Treatment

How this company has solved waste treatment problems for such industries as electro-plating, refinery, gas, and metal finishing is treated in detail in six-page booklet 70-B. Cross-sections show the various types of chemical and biological treatment equipment. A handy bibliography serves as a reference for more information on waste treatment in each of the industries covered. Infilco, Inc.

WATER TREATMENT

366—Water Analysis

Published by a company engaged exclusively in the solution of industrial water conditioning problems, this 14-page brochure contains brief descriptions of testing and control equipment necessary for the more common water analyses. W. H. & L. D. Betz.

367—Water Purification

"Boiler Feedwater Treatment," 19-page bulletin BFT-1, covers Inversand zeolite softeners, color process chemical softeners, and demineralizing units, including silica removal by ion-exchange. Each process is explained by means of chemical formulas and flow diagrams. Hungerford & Terry, Inc.

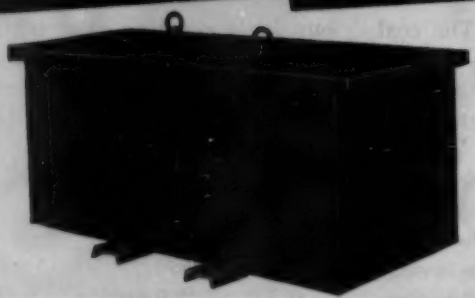
368—Ion Exchange Material

Strongly basic anion exchanger is presented in 16-page bulletin 57. Includes complete data on physical characteristics, exchange capacity and regeneration technique. Tables and graphs along with discussions explain performanse under various conditions. National Aluminate Corp.

369—Diatomite Filters

How filtration of water, or other liquids for industrial use, can be obtained simply, economically, and efficiently by means of this company's diatomite filters is described in Bulletin WC-115. Text, photographs, and schematic diagrams show typical arrangements of the unit. Graver Water Conditioning Co.

3 PHASE TRANSFORMERS 3 KVA THRU 750 KVA



Next time you need 3 phase, dry type transformers in a hurry, check the performance data, practical mechanical features, as well as the price of Acme Electric dry type transformers. Stock sizes from 3 thru 750 KVA, all standard primary voltages up to and including 5 Kv. There's a Service Dealer with stock on hand — as close as your telephone.

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The Johnson Corporation
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Con Edison specifies "K" Monel pump shafts for New Astoria Station

At their first all-new plant in 25 years, the Consolidated Edison Company means to take no chances with pump shaft trouble.

The Astoria Station, now under construction at the edge of New York's East River, has four single-stage vertical mixed flow pumps (each with a capacity of 68,500 gpm) to circulate water for its condensers. Made by Economy Pump Division of H. C. Wheeler Manufacturing Company, *all four pumps have "K" Monel shafts, as specified by Con Edison engineers.*

They singled out this rugged shafting material for several important reasons. For one thing, they knew "K" Monel offered them excellent resistance to corrosion. This was a basic need, for water drawn from the brackish, sewage-polluted East River is highly corrosive.

They wanted, too, a shaft metal that had great strength and hardness, and high resistance to corrosion fatigue.

"K" Monel meets all these requirements. And it has the additional advantage of being heat-treatable *after* machining without undue distortion.

There's valuable information for pump users in our booklet, "*How to get longer service from your pumps.*" A copy belongs on the desk of every man concerned with the operation, maintenance or purchase of pumping equipment. The booklet will be sent promptly — without cost or obligation. Write for it — *today*.

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Inco Nickel Alloys INCO

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"KR"® MONEL • "S"® MONEL • INCONEL®
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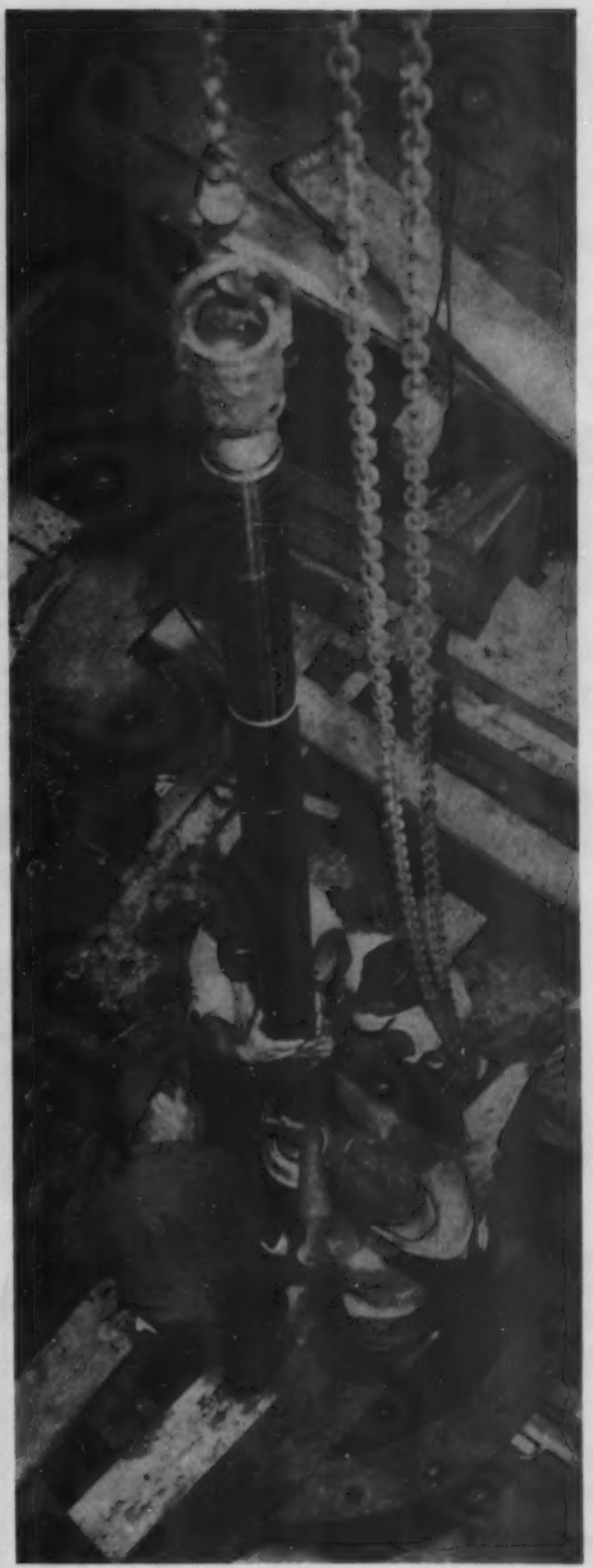

One of four. Workmen lower a "K" Monel shaft into a giant SAFV Wheeler-Economy pump at Con Edison's new station in Astoria, N. Y. This shaft is 6 inches in diameter, 27½ feet long, and weighs 1,900 pounds. It has a minimum Brinell hardness of 265. In operation, the pump, with a total dynamic head of 16 feet, will be driven at 233 rpm by a 400-hp motor.

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bulletins

—Starts on page 94

370—Water Conditioning

Conditioning for boiler, process, and general application is discussed in 20-page booklet 611A. A zeolite unit for manual and automatic operation is featured. In addition, chemical feed, zeolite-post treatment, zeolite-alkalinity neutralization, split-stream, and anion exchange dealkalization systems are explained. Elgin-Refinite Div. of Elgin Softener Corp.

371—Ion Exchanger

"Demineralization Including Silica Removal by Ion Exchange," 35-page booklet 3803, describes applications, principles of operation, design features, and advantages, and gives recommendations and specifications for demineralizing and silica removal apparatus and synthetic resins. The Permutit Co.

372—Ion Exchangers

This 14-page booklet reviews generally the subject of ion exchange, established and potential applications. It gives advantages of the synthetic ion exchange resins and a bibliography of papers concerning their use. Rohm & Haas Co.

373—Water Sampling

Are you sure you know the which, when, and where of obtaining samples for proper control of water conditions in your power plant? "Effective Water Sampling," folder 28X7980, gives concise information on each phase of water sampling. Allis-Chalmers Manufacturing Co.

374—Water Softener

ZEO-FLO Sodium Zeolite Softener, a water softener specially designed for small and medium size industrial plants, laundries, and hospitals, is described in four-page folder 4505-A. How the softener has been simplified so that installation may be handled readily by the facilities of a small or medium sized plant is explained. Cochrane Corp.

375—pH Control

"Automatic pH Control in Water and Industrial Waste Treatment," eight pages, is a reissue of a paper delivered by R. T. Sheen, president of this company. Outlined are several typical systems of automatic pH control in boiler feed water treatment, using air- and motor-operated valves as well as controlled volume pumps to effect proper addition of chemicals. Milton Roy Co.

376—Feedwater Alkalinity

"Experiences with Filming Amines in Control of Condensate Line Corrosion," technical paper 127 attributes condensate line corrosion chiefly to the presence of carbon dioxide in the steam and water. Various methods of minimizing boiler feedwater alkalinity are discussed, especially the employment of filming amines. W. H. & L. D. Betz Co.

377—Boiler Water Treatment

Difficulties caused through industrial water contamination are outlined in a 12-page catalog. Recommended water conditioning treatments for scale, sludge, corrosion, carryover and other boiler conditions, and efficient control methods are described. Details of a system of complete boiler water conditioning are fully explained. E. F. Drew & Co., Inc.

378—Deaerators

Spray-atomizing type units are shown in cross-section in four-page booklet 400. Function, design and operation, construction, outstanding features, and uses are discussed. American Water Softener Co.

379—Boiler Water Foam

Laboratory pictures in this four-page folder show how Concentrol controls boiler water foam. Examples of its use in various industries are given along with an explanation of foaming. Bird-Archer Co.

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380—Chlorinizers

Chlorination—the modern way to prevent slime buildup in condensers and heat exchangers—saves you money if its right. But if dosage is too heavy, you run the risk of corrosion, according to application memo 840-J9. Chlorinizers available in three volumetric models for feeding from a few pounds to 6000 pounds per day are described. Builders-Providence, Inc.

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Handles oil?	Light oil only	No	Very well
Handles dirt?	Moderate	No	Very well
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Requires priming?	No	No	Yes
Float collapse or leakage?	Remote	Remote	Impossible
Gravity drainage to trap required?	Yes	Yes	No

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BETTER PRODUCTS AT LOWER COSTS - *by fabrication*

Photo above is all-steel punch press frame. Tho a third lighter than expensive castings it replaced, greater strength and rigidity of welded construction enable punch press to operate 50% faster.

Besides basic saving of material, plus values are reduced freight and handling costs, easier machining qualities. And future design changes can be made at nominal cost.

Because steel can be formed or cut into almost any size, shape or thickness, doubtless some of your own castings can be replaced by fabricated steel, at really worth-while savings.

Send us a print or a sketch of your product. Or if you wish our engineer will call on you. No obligation in either case.

THE FOSTER COMPANY, Saint Joseph, Mich.

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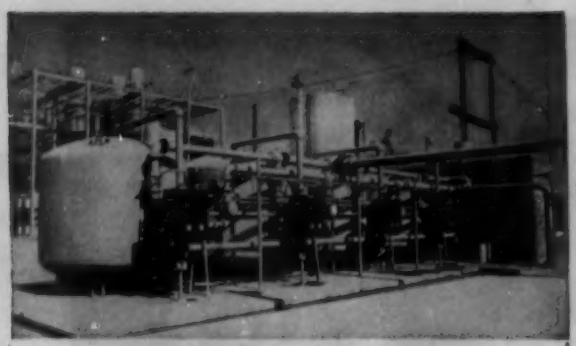

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meetings

. . . and exhibitions

Aug. 25-27	Western Electronics Show and Convention	Los Angeles, Calif.
Sept. 8-10	American Society of Mechanical Engineers (Fall Meeting)	Hotel Schroeder Milwaukee, Wis.
Sept. 12-16	American Institute of Chemical Engineers (Fall Meeting)	Colorado Hotel Glenwood Springs, Colo.
Sept. 12-16	Illuminating Engineering Society (National Technical Conference)	Chalfonte-Haddon Hall Atlantic City, N.J.
Sept. 15-17	Compressed Air and Gas Institute Meeting	Skytop Lodge Skytop, Pa.
Sept. 15-20	Instrument Society of America (International Instrument Exposition)	Convention Hall Philadelphia, Pa.
Sept. 27-29	American Institute of Electrical Engineers (Petroleum Conference)	Mayo Hotel Tulsa, Okla.

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Developed especially for the efficient handling of high temperature and highly volatile liquids. Delivers outstanding performance. Unbeatable on high head, small capacity duties.

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books & films

. . . of special interest

NFPA HANDBOOK OF FIRE PROTECTION, 11th Edition, Edited by Robert S. Moulton; National Fire Protection Association; 1656 pages; $10.50. This 11th addition of the NFPA Handbook presents the essential information on fire prevention and protection that time has crystallized into good practice. The Handbook is the only reference volume of its kind available today, and it represents two-year's work on the part of the National Fire Protection Association staff with the assistance of a number of expert consultants. The Handbook should be useful to the experienced fire protection engineer, architects, inspectors, and industrial management who are anxious to secure the latest fire protection engineering information.

Automatic spray sprinklers, developed since the last edition was published, are fully described and illustrated. New dry pipe valves, water flow alarms, and other automatic sprinkler devices are illustrated with diagrams showing construction and method of operation. The chapter on Water Spray, completely rewritten, contains tables of discharge characteristics of each brand and model of spray (fog) nozzle.

The tables of flammable liquids and hazardous chemicals have been revised to include new chemicals as additional data has become available during the past five years.

Tables of automatic sprinkler performance in actual fires and of the causes of fires by occupancy classification, based on an analysis of over 50,000 fires, have been revised to present an up-to-date statistical background for fire prevention measures.

ALSO AVAILABLE

NEMA STANDARDS FOR POWER CIRCUIT BREAKERS, Publication No. SG4-1954; National Electrical Manufacturers Association; $5.00. Rating, manufacturing, testing, and application are covered in this new edition of the NEMA Standard for Power Circuit Breakers. The testing standards have been considerably expanded in this edition and cover both design and routine tests. The book also contains information concerning the installation, operation, and care of power circuit breakers, and the terms used throughout the publication are defined.

AUTOMATIC CONTROL OF HEATING AND AIR CONDITIONING, by John E. Haines; McGraw-Hill Book Company; 354 pages; $6.75. This book is devoted solely to automatic control as applied to heating and air conditioning. It first introduces basic principles, then illustrates them by describing construction and characteristics of representative control devices. Finally, the author tells how to combine individual control devices into control systems. After a thorough explanation of electric-control circuits and pneumatic-control circuits comes a description of various representative types of units used in these two systems.

The author gives special attention to radiant panel heating and developments in that field. Typical control systems for panel heating are described.

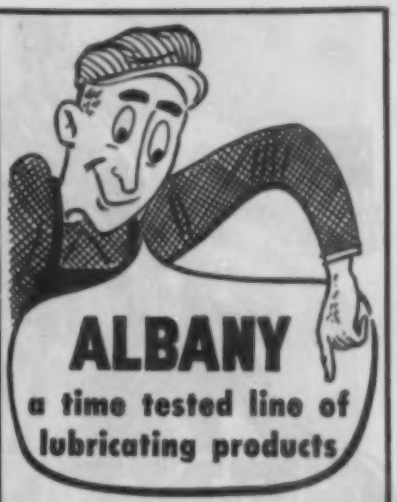
DIESEL AND HIGH COMPRESSION GAS ENGINES — FUNDAMENTALS, by Edgar J. Kates; American Technical Society; 396 pages; $5.50. The author, Edgar J. Kates, is an engineer well-known in the diesel engine field. He is a fellow of the American Society of Mechanical Engineers and has served as chairman of the Oil & Gas Power Division of that Society. In this book Kates has provided a middle ground which enables both the technical and non-technical reader to gain a basic understanding of the principles, construction, and operation of the diesel and the high compression gas engine. Since a considerable amount of this book is given to the high compression engine, it will be of value to engineers investigating this type of prime mover.

INDUSTRIAL FILMS

"DYNAMIC MEASUREMENT," Consolidated Engineering Corp., sound and color, 16 mm, 30 minutes. Viewers of this film go behind the scenes with design engineers of a large manufacturer of oil refining plants to observe how tiny sensing devices known as "pickups" transmit electric signals to permanent oscillograph records to give warning of vibration factors that could seriously impair the delicate balance of a cooling tower fan. A number of other interesting applications of Dynamic Measurement are also reported.

"THE STORY OF THE ROUND-WOUND TRANSFORMER," Line Material Company, sound and color, 16 mm, 22 minutes. This movie explains the manufacture and testing of distribution transformers through 500 kva.

To order books or films, write to Book Editor, Industry and Power



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A cooling lubricant for operating temperatures from 110° F to 200° F.

ALBANY PRESSUREGREASE
A superior waterproof mineral oil grease of high viscosity. Comes in Liquid, Soft, Medium, Hard and Graphite Pressuregrease Soft and Medium.

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Will not separate or oxidize assuring long life to bearings. May be used in hand grease guns.

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Retards wear, quiets gears. Waterproof. Will not drip when gears are idle or in motion.

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Quick-acting. Cuts rust as well as lubricates. Loosens sticky valves, eliminates squeaks.

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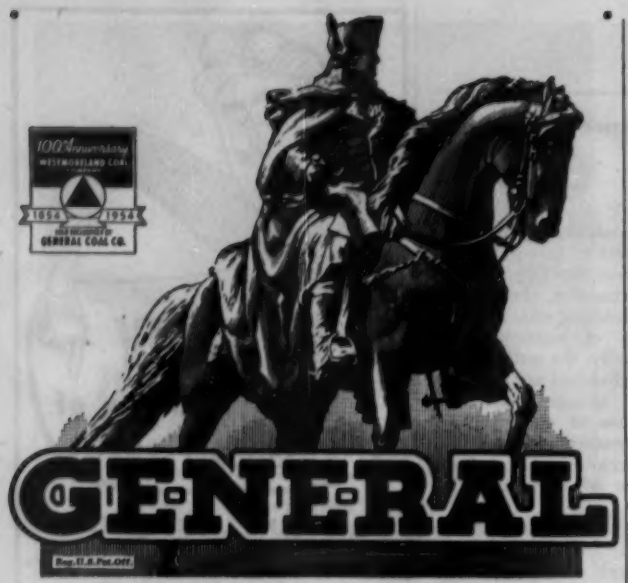

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spot news

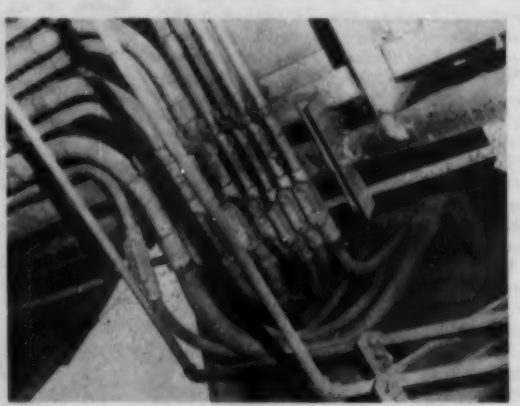
—Starts on page 88

Hardwood Inserts Add Service to Railroad Crossties

Hardwood inserts, placed between the crosstie and steel plate supporting the rail, are proving to be another successful means of extending the service life of crossties, according to the Timber Engineering Company, research affiliate of the National Lumber Manufacturers Association.

Purpose of the insert is to prevent the tie plate from cutting the crosstie when trains pass over the rails. Both solid and laminated inserts are being produced at the laboratory using various hardwoods such as birch, maple, hickory, and black gum, preservatively treated.

In addition, an edge-grain, mechanically laminated lumber insert, only 1½ in. thick, is being prepared for its initial tryout in track service. Other studies under the joint sponsorship of the Nation's railroads and the lumber industry include the effectiveness of tie coatings and a combined seasoning and treating process for minimizing tie checking and splitting.



Flexible Electrical Conduit Approved for Wet Locations

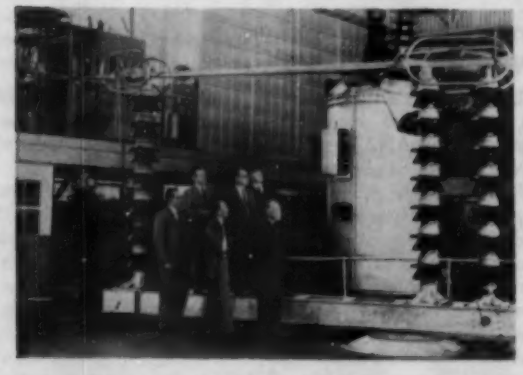
For applications where electrical conduit must not only overcome problems of movement, vibration, and misalignment, but also be moisture-proof, Underwriters' Laboratories has approved Sealtite Flexible Conduit Type UA as shown in use at U. S. Steel's Fairless Works at Fairless Hills, Pennsylvania.

These Sealtite assembles house all the power lines to the top of the skip-hoist of blast furnace #1. This is a place where the power lines jump from one structure, the framework surrounding the blast furnace, to a second completely independent structure, the frame work for the skip-hoist.

The skip-hoist is subject to considerable vibration due to the hoisting of cars which haul furnace charge to the top of the furnace. The conduit, a product of the American Metal Hose Branch of The American Brass Co., has proved to be trouble-free although it is exposed to year 'round weather and the accumulation of dust from the furnace charge.

He is shown pointing out the location of a truck to K. L. Avery, plant foreman.

Indiana Bell Telephone Co. installed the radio-telephone units on the plant trucks.



Engineers Inspect 330 kv Switch

The 330 kv TTR disconnecting switch shown during one of its acceptance tests is one single pole of 34 three-pole switches to be installed at Clifty Creek Station of the Indiana Kentucky Electric Corp., a unit of Ohio Valley Electric Corp.

Featuring the new straight-line high momentary jaw, it has 1600 amp continuous current rating and 1300 kv impulse withstand voltage. Manufacturer is R&IE Equipment Div. of I-T-E Circuit Breaker Co.

Left to right are: R. L. Retallack, AG&E Service Corp. transmission engineer; Arem Foti, R&IE engineer; A. C. Bates, R&IE laboratory manager; E. A. Williams, R&IE chief engineer; I. W. Gross, AG&E Service Corp. research engineer; and J. H. Kuhns, R&IE New York representative.

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Wilson brings you a complete line of fast-acting tube cleaners. They handle every kind of deposit, hard or soft, thick or thin or variable in depth. Driven by air, steam, water or electricity, these powerful cleaners make quick work of cleaning straight or curved tubes.

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Wilson Tube Expanders are precision-made. Their smooth, efficient rolling action insures firm seating of the tube ...provides perfectly rolled joints... reduces time-wasting re-rolling and re-inspection. There is a Wilson Tube Expander for every need from 3/16" ID to 12" ID and up.

Special Tools

Wilson also offers a wide range line of boiler maintenance and erection tools. The handy chamfering tool shown at right chamfers the tube edge to a 45° surface at high speed...makes repairs much faster than outdated hand methods. Also available is an inside chamfering tool for placement of chill rings. Write for more information on these tools.

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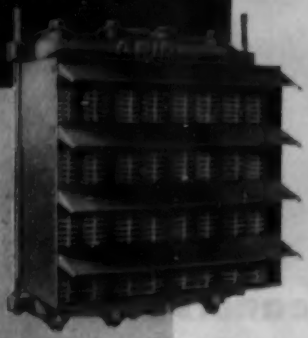
Unit Heaters

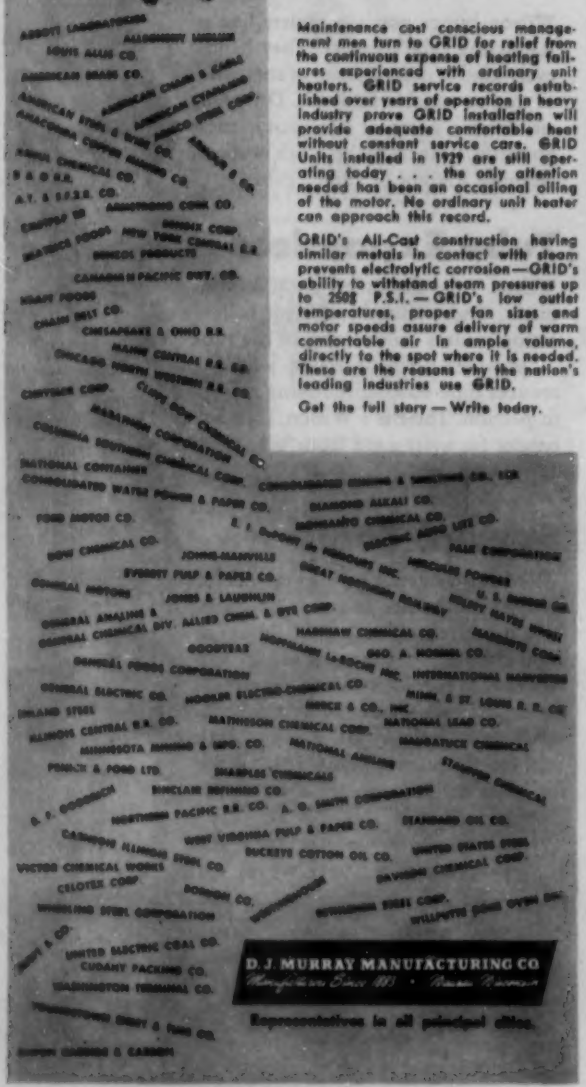


and here's why...

Maintenance cost conscious management men turn to GRID for relief from the continuous expense of heating failures experienced with ordinary unit heaters. GRID service records established over years of operation in heavy industry prove GRID installation will provide adequate comfortable heat without constant service care. GRID Units installed in 1929 are still operating today . . . the only attention needed has been an occasional oiling of the motor. No ordinary unit heater can approach this record.

GRID's All-Cast construction having similar metals in contact with steam prevents electrolytic corrosion—GRID's ability to withstand steam pressures up to 250# P.S.I.—GRID's low outlet temperatures, proper fan sizes and motor speeds assure delivery of warm comfortable air in ample volume, directly to the spot where it is needed. These are the reasons why the nation's leading industries use GRID.

Get the full story—Write today.



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spot news

—Starts on page 88

Underwriters Approve Larger Explosion-Proof Motors

Underwriter's Laboratories, Inc. approval of a 1250 hp, 2300 v, 1780 rpm Allis-Chalmers explosion-proof motor (Type ANZZ) signals extension of the company's entire line of explosion-proof motors.

Ratings up to 800 hp, 3600 rpm previously have been approved for Class I, Group D, and Class II, Group F and G hazardous locations. The label for operation in Class I, Group D locations will also apply to the company's motors of a similar construction in which the internal free volume and physical dimensions do not exceed that of the motor tested.

Allis-Chalmers explosion-proof design is a modification of their totally-enclosed, fan-cooled motor line with tube-type air-to-air heat exchangers.

One Man Controls Unloading Operation

Virtually all coal used at the new Hennepin Power Station of the Illinois Power Co. is unloaded from river barges by specially designed equipment constructed by Dravo Corp. Operating along a 100-ft runway supported by the tower, the rope-type trolley handles a 6½-ton clamshell bucket to dig coal from barges on the Illinois River.

With a 35-sec free-digging cycle, the unloader can deliver some 670 tons of coal hourly. Average performance, including barge-shifting and cleanout, is 450 tons an hour. One man controls the entire operation.

Predict Maintenance Costs to Double in Ten Years

Forecasting that industry in the next ten years will double its maintenance expenditures to about $22 billion annually, H. F. McCullough, general manager of General Electric Company's Service Shops Department, outlined five basic steps necessary for establishment of an efficient maintenance system:

(1) Gather complete equipment data;

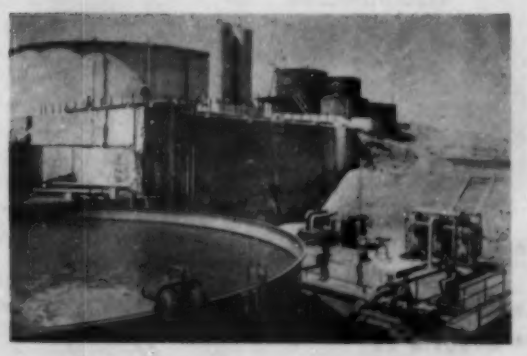
(2) Evaluate routine maintenance so that cost of equipment will show amount of care warranted;
(3) Establish a routine operating control system;
(4) Evaluate critical maintenance needed;
(5) Establish critical maintenance program.

His remarks were addressed to Cleveland area engineers attending the first of a series of Productive Maintenance Forums to be held in major U. S. cities under sponsorship of GE's Apparatus Sales Division.

Steam Generators Powerful For Size

Steam to heat the plant during the day, as well as 200 lb steam pressure for manufacturing operations is produced at the new Niles, Illinois plant of the Vapor-Clarkson Corp. by generators manufactured by the company itself. Developing 200 psi in two minutes from cold water, the units are said to be the most powerful boilers yet developed in their size and weight class.

W. C. Keeron, vp of engineering (left), and J. E. LaRocque, development engineer are shown inspecting the generators.

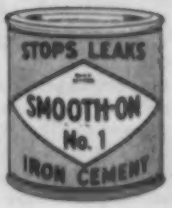


MORE POWER FOR NITRATE INDUSTRY

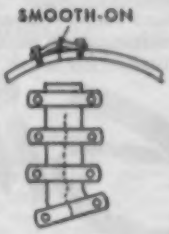
Engineers and diesel plant operators of Anglo-Lautaro Nitrate Corp., in collaboration with Nordberg Mfg. Co., incorporated many new design and operating ideas into the Coya Sur, Chile, diesel power plant. In the foreground is the hot jacket water sump; upper left, the cold sump; upper center, fuel oil service tanks; and distilling plant and heat exchangers, right.

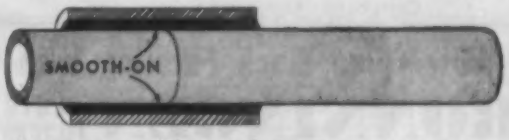
QUICK, LOW COST EMERGENCY Repairs

When you just *have* to get a boiler, or machine or plumbing system back in working condition fast, Smooth-On Iron Cement saves the day . . . and saves you many dollars, too. It makes the repair quickly. Tides you over until the permanent job can be done.

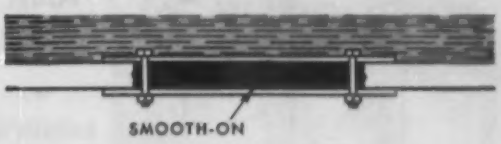


Reinforced Crack Repairs in boilers, water tanks, etc., can be made with Smooth-On No. 1 Iron Cement, as shown. Smooth-On is forced into the crack and a patch plate is then applied over the area with straps held in place by machine screws. As Smooth-On hardens it expands against the patch, making a tight, durable seal.





Emergency Pipe Joint. The same expansion principle applies here. Put the pipe ends into a section sawed from a larger pipe and pack tightly with Smooth-On.



Broken Parts. A broken casting can be repaired temporarily, as illustrated. You make a Smooth-On "sandwich" by bolting on a patch plate at top and bottom.

These are just a few of the many emergency repairs possible with Smooth-On. Better keep a can on hand! Others are described in the *free* Smooth-On Repair Handbook. Ask your supply house for a copy or write us.

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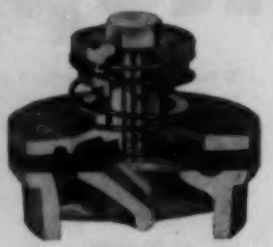

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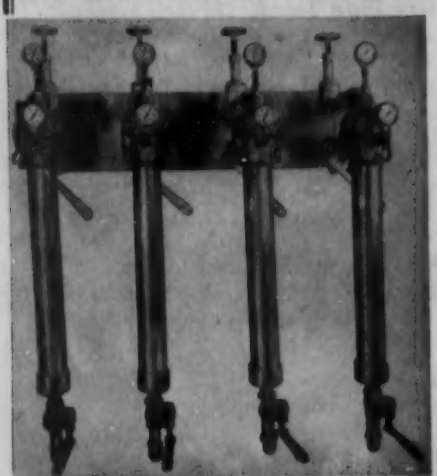

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spot news

—Starts on page 88

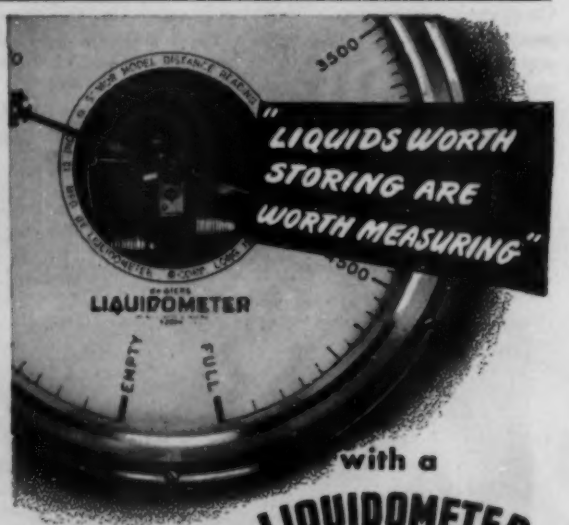
New Purchase Policy Announced for Turbo-Generating Equipment

Aimed at leveling out the customary "peaks and valleys" in the ordering of heavy power-generating equipment, General Electric's Turbine Division has announced a new policy designed to stimulate orderly purchase of such equipment, ease the financing process, and maintain optimum employment and use of engineering and manufacturing facilities.

Under this plan, G. E. will undertake initial engineering and manufacturing work on large equipment orders with provision that such orders may be cancelled up to six months later at a minimum amount of the contract price. This "cancellation charge," according to G. B. Warren, vice president and general manager of the Division, would be much less than the normal customer liability and less than actual factory cost incurred.

In the case of early shipment orders, concellation will be required 12 months in advance of scheduled delivery.

In addition, G. E. will endeavor to work out a means of financing charges normally made prior to shipment until financing of the new equipment can be handled by the customer.



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MOTORS — 280 hp, 2300 v, 3 phase, 900 rpm
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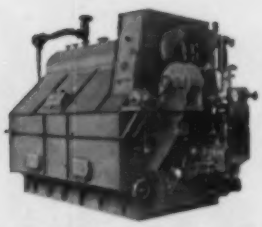

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